SCIENTIFIC AMERICAN

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A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

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EDISON DYNAMO AND MOTOR.

The SCIENTIFIC AMERICAN has repeatedly given detailed descriptions of small dynamos and electric motors copiously illustrated with first class engravings. These articles have enabled many mechanics and amateurs to construct machines which have proved more or less satisfactory, according as the work has been well or poorly done.

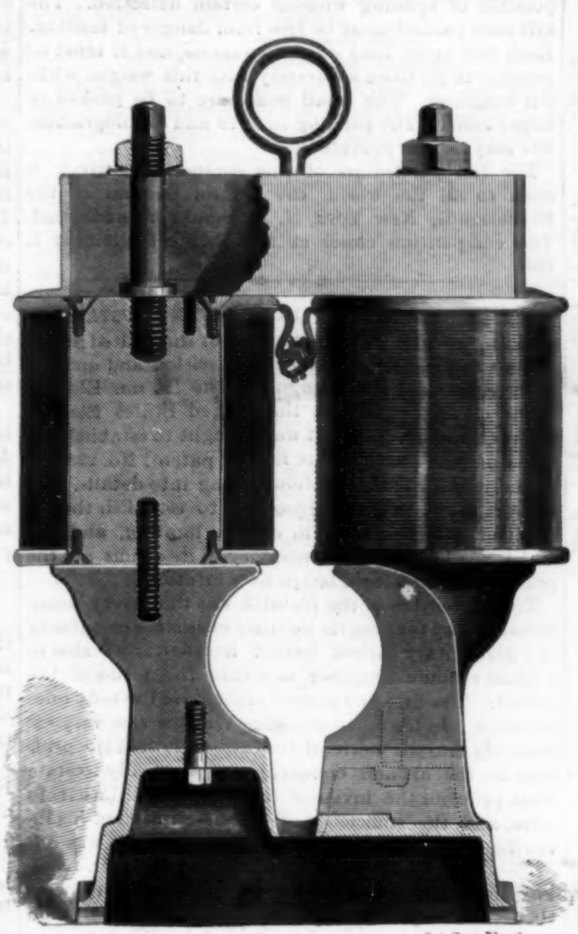
It is one thing to make a dynamo or motor from explicit instructions and quite another thing to design a machine adapted to generate or be operated by a particular current. The former is purely mechanical and within the range of most machinists and amateurs, while the latter is entirely within the province of the electrical engineer or electrician. When the work of machine building proceeds simultaneously with the study of fundamental principles, real progress is made. For the benefit of those who proceed in this way, and in answer to many inquirers, we give a detailed description of an Edison .25 kilowatt machine, designed for use as a dynamo for supplying a current for five Edison standard lamps, or for use on the Edison circuit as a quarter horse power motor.

Before beginning the description of the machine it is but fair to say that it is thoroughly well made in every particular. The insulation in every part is very perfect, and the whole is so well made that any single machine built by a mechanic or amateur could but suffer by comparison with it; and furthermore, we doubt if any maker of a single machine could even purchase the materials required for the price asked for the machine by the regular manufacturers. Therefore, if the machine is wanted, we advise a purchase. If experience is wanted, the making of the machine comes first in order, with a probable purchase to follow.

The engravings are one-third the actual size, linear measurement.

The base, which is of brass, is made hollow, as shown. It is 14 in. long, 7⅝ in. wide, 1¾ in. deep at the ends, with two 1⅛ in. elevations at the middle for receiving the cast iron pole pieces of the field magnet, which are each secured to the base by two small tap bolts extending upwardly through the base and into the pole pieces.

The upper surfaces of the pole pieces are truly faced for receiving the cylindrical field magnet cores, which are made of Swedish iron, 2⅝ in. in diameter and 4⅛ in. long. These magnet cores are each held in position by a threaded stud screwed into the pole piece and entering magnet core. Each core is provided with a vulcanized fiber collar at each end, which is ¼ in. thick and ⅞ in. wide. Upon each core, and between the fiber collars, is wound 5¼ lb. of No. 24 silk-covered copper wire, with a wrapping of thin varnished paper between the layers. The cores, before winding, are thoroughly insulated with the same material. The fiber collars are each held in place by three conical-headed screws entering the end of the core, with their heads projecting beyond the body of the core. To the inner and outer ends of the winding of each arm of the magnet are attached pieces of larger wire to avoid breakage, and the inner ends are led out through grooves in the fiber collars. The yoke, of Swedish iron, is 2⅝ in. wide, 2⅛ in. thick and 7⅛ in. long. It is held in position on the cores by two ⅛ in. bronze studs, each threaded at the upper and lower ends, and furnished with a collar which fits into the counterbored part of the hole in the yoke. The studs are squared at the upper end to receive a wrench, and a nut is placed on each stud above the yoke for clamping it securely after adjustment. The machine is regulated or adapted to any work requiring less than its full power by raising the yoke more or less. The yoke is provided with an eye, by means of which the machine may be lifted.



SIDE VIEW OF FIELD MAGNET, PARTLY IN SECTION.

Front and rear boards of mahogany are arranged on opposite sides of the yoke, and held in place by brass plates at the ends.

The outside ends of the field magnet coils are connected with binding posts on the rear board.

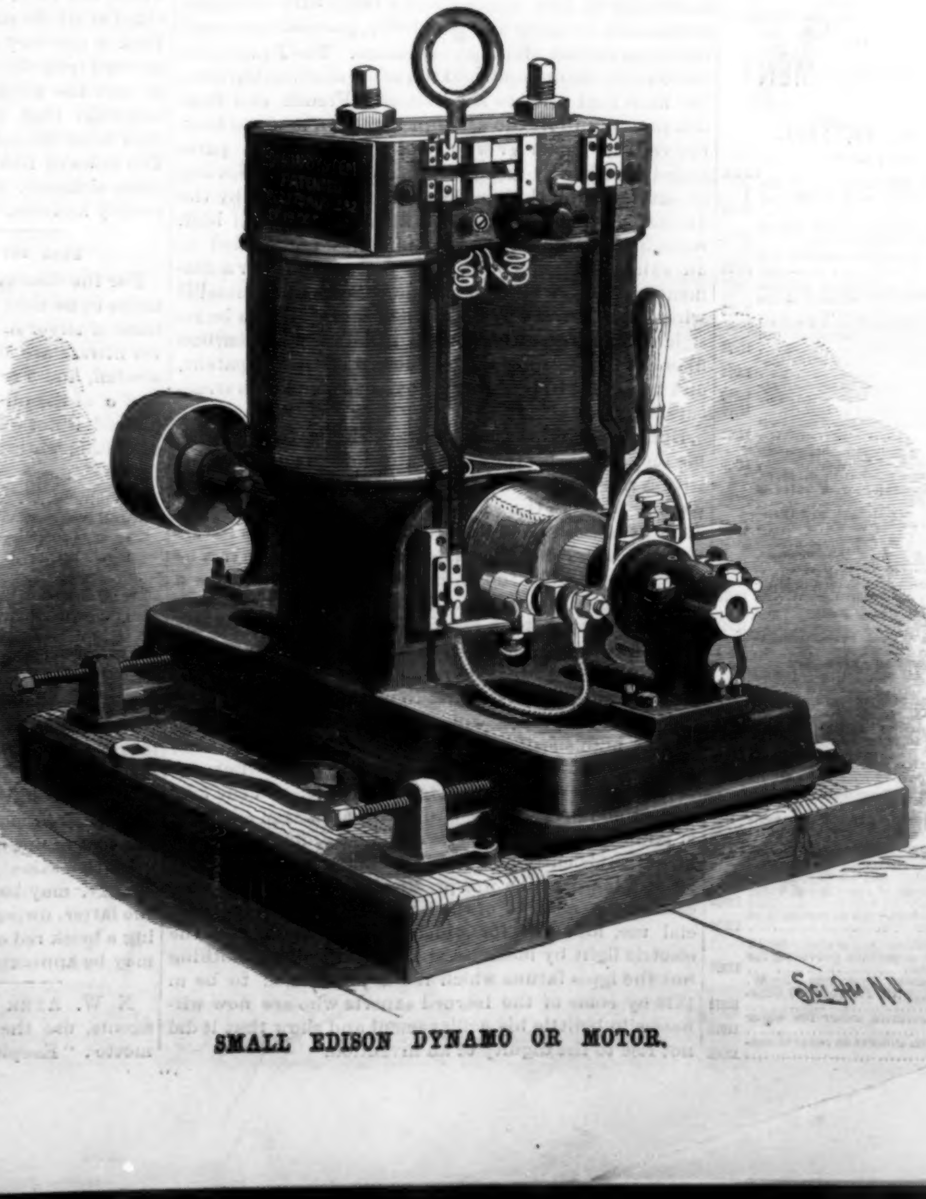
A variable resistance of ten or fifteen ohms is inserted between these posts when the machine is used as a dynamo. In the front board, at the right hand side, is secured a bronze casting known as the right hand motor head field magnet terminal. This is adapted to receive the line wire, also one of the leads, the upper end of which is screwed to the casting. The lower end of the lead is secured to a lead terminal attached to a block of wood secured to the right hand pole piece. At the right hand side of the machine a similar arrangement of the lead is found, but the upper lead terminal is made in two separate parts, one attached to the lead, the other being connected with the line; both being furnished with copper switch tongues. The switch arm turns on a stud projecting from the front board and carries a loose triangular switch plate of copper, having a knife edge which readily enters between the switch tongues. The switch has a T-handle of hard rubber, by means of which it is turned. A stop pin projecting from the front board limits the rearward movement of the switch arm.

The inside end of the right magnet coil is connected with the right hand lead, and the inside end of the left hand magnet coil is connected with the lower half of the left hand lead terminal.

At opposite ends of the base there are plane surfaces to which are secured the self-oiling bearings of the armature shaft. Each bearing has a hollow standard furnished with a cap, which, together with a cross piece in the hollow standard, forms a support for the spherical central portion of the bronze sleeve forming the journal box proper.

This sleeve is shorter than the outer portion of the bearing, and is slotted across the top to allow two brass rings to ride upon the armature shaft. These rings dip in the oil in the hollow standard, and as they revolve carry oil to the shaft in quantities more than sufficient for the purpose of lubrication. The oil is distributed throughout the bearing by means of spiral grooves formed in the inner surface of the journal box. The surplus oil drops back into the hollow standard. A screw plug in the lower portion of the standard

(Continued on page 54.)



SMALL EDISON DYNAMO OR MOTOR.

Scientific American.

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NEW YORK, SATURDAY, JULY 25, 1891.

Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 812.

For the Week Ending July 25, 1891.

Price 10 cents. For sale by all newsdealers.

SALT PACKING—A $4,000 PRIZE CONTEST.

The government of Netherlands-India has offered the above prize to be awarded in competition as to the best method of packing salt. The salt works, which are run by the government, produce solar salt. This is stored away for a year or more, during which period it dries out and loses its hygroscopic elements in great part. It is, however, still inclined to absorb water, to become moist, and to liquefy. The conditions to be filled in packing are: 1st. The package must be proof against the action of the salt, and must not soil it or impart taste or odor. 2d. The package must preserve the salt at least two years. 3d. The package or box must close in a practical and effective manner, and be impossible of opening without certain detection. The salt once packed must be free from danger of melting. Each box must hold one kilogramme, and it must be possible to fill them accurately with this weight without weighing. The small boxes are to be packed in larger cases. The packing in 5, 10 and 25 kilogramme lots may be also provided for.

For full particulars of this competition, which is open to all the world, the Consul General of the Netherlands, New York, N. Y., should be addressed. The competition closes at the Hague, September 1, 1891.

THE EDISON ELECTRIC LAMP PATENT SUSTAINED.

On July 14, 1881, Judge Wallace, of the United States Circuit Court, handed down his decision and opinion in the celebrated suit brought by the Edison Electric Light Company against the United States Electric Light Company. The suit was brought to establish the scope of true claims of the Edison patent, No. 223,898, of January 27, 1880. Without going into details, it is enough to say that the object was to establish the validity of a basic patent in electric lighting, and one which would include as tributary to its claims all the practical incandescent lamps now in use.

The contention of the plaintiff was that every incandescent lamp for electric lighting consisting essentially of a filamentary carbon burner hermetically sealed in a glass vacuum chamber is within the terms of the patent. The first and second claims are the only ones involved. In his opinion Judge Wallace rose very extensively into the merits of the case, reviewing the prior state of the art and endeavoring specifically to state what problem the inventor had addressed himself to solve, and the sufficiency of his description of his invention for the capacity of those to whom it was addressed. At that time the Judge states that Mr. Lane-Fox, in England, and Mr. Edison, of this country, were almost the only ones who believed that the subdivision of electric light might be effected by incandescent lamps of high resistance and small radiating surface, arranged in multiple arc. In those days electricians knew how to make high resistance conductors and how to vary their resistance, but what was wanting was the knowledge of how to construct a lamp with adequate mechanical strength and durability, possessing a small radiating surface and high resistance. The Judge cites the Sawyer-Mann lamp and the other old-time burners, but finds that prior to Mr. Edison's French and English patent, in 1879, no attempt had been made to form the vacuum chamber wholly of glass, with all parts sealed together by fusing. The description of novelty as set forth in the specification is accepted by the Judge. It includes a carbon filament or wire of high resistance connected to platinum wires and sealed in an exhausted glass bulb. The first claim is for a filamentary carbon of high resistance secured to metallic wires, as set forth. This the Judge concludes to be restricted to a connection between platinum and carbon filament by a specific method described in the patent, and hence not to be infringed by the defendant's structure.

But the second claim was awarded the fullest possible scope. It is for the combination of a carbon filament with a receiver made entirely of glass, and conductors passing through the glass, and from which receiver the air is exhausted. It will be readily seen that this covers the typical incandescent lamp of the present day. The specification, the Judge holds, discloses what was a radically new discovery: that it is possible to make a stable, extremely high resistance wire adapted for use in giving light when sealed up in an exhausted glass globe. In the Judge's words:

"He (Edison) was the first to make a carbon of materials and by a process which was especially designed to impart high specific resistance to it; the first to make a carbon in the special form for the special purpose of imparting to it high total resistance; and the first to combine such a burner with the necessary adjuncts of lamp construction to prevent its disintegration and give it sufficiently long life. By doing those things he made a lamp which was practically operative and successful, the embryo of the best lamps now in commercial use, and but for which the subdivision of the electric light by incandescence would still be nothing but the ignis fatuus which it was proclaimed to be in 1879 by some of the learned experts who are now witnesses to belittle his achievement and show that it did not rise to the dignity of an invention."

The Judge's reference to those whom he terms "the learned experts" will be appreciated by the reader.

One good point brought out in the subsequent part of the opinion is that an inventor is entitled to all that his claim covers, independent of what he or his solicitor may have thought about the meaning of the claim. The Judge says:

"There are many adjudicated cases in which it appears that the inventor builded better than he knew; where a patent has been sustained for an invention the full significance of which was not appreciated by the inventor when it was made. In the case of the Bell telephone patent there was great room for doubt whether the speaking telephone had been thought of by Mr. Bell when he filed his application for a patent, but the Court said: 'It describes apparatus which was an articulating telephone, whether Bell knew it or not.' 88 Blatch., 532."

The nearest approximations to the invention, according to the opinion, were the ribbon-shaped carbon burner of low resistance of Mr. Farmer, never sufficiently used to constitute public use, and the low resistance carbon rod burners of Sawyer and Mann. The Judge states that it is impossible to resist the conclusion that the invention of the slender thread or carbon as a substitute for the burners previously known opened the path to the practical subdivision of the electric light. This conclusion, coming near the end of the opinion, emphasizes the Judge's opinion as to the invention involved in the carbon filament as contrasted with a rod or large conductor of carbon.

The amount of money involved in the suit is very large upon its face. The accounting alone, independent of the future six years' income, would be very large. In one sense the decision and accompanying opinion will be welcome as indicating a liberal and not too technical construction of the claim of a patent.

An Artificial Railway Valley.

The tracks of the Harlem Railway, where they pass through the city of New York, traverse a dense population. The distance from the northerly boundary of the city to the Grand Central Depot, at Forty-second Street, is something over twelve miles. There are four tracks. These carry the traffic of the Harlem, the New York Central, and the New York, New Haven, and Hartford lines. The increase of population has rendered it necessary, as a measure of safety at street crossings, to lower the grade of the tracks and raise the grade of the streets at the crossings. This work, which has been in progress for several years past, has lately been completed. The masonry is very massive and substantial. The cost has been very great—some six millions of dollars in all. Going north from Forty-second Street, there are tunnels for nearly two miles. Beyond these a one mile viaduct and then an open cut, or as it might be termed a deep groove, the sides of which are lined with granite walls. Bridges are provided at all the street crossings. The approach to New York is not very attractive to the traveler. Looking upward from the narrow valley in which he is inclosed, he sees the windows in the upper stories of the high buildings that line the railway avenue. The lateral view from the car is simply a solid rampart of stone. Ten miles of this sort of sight seeing is rather monotonous, although the distance is run in from fifteen to twenty minutes.

Test for Olive Oils and Seed Oils.

For the discrimination of olive oils and other oils liable to be used for adulteration, R. Brulle applies nitrate of silver in the following manner: 25 parts of silver nitrate are dissolved in 1,000 parts of 95 per cent alcohol, and 5 c. c. of this solution are added to about 12 c. c. of the oil under examination, which should be filtered if not quite clear, then the test tube is heated in boiling water, and the effect observed.

Kind of oil.	Color after heating in boiling water.
Virgin olive oil	Bright green.
Olive oil of second and third pressures, containing some olive kernel oil	Darkens slightly, quickly changing to intense green.
Olive oil of inferior quality, strongly colored	Same as previous oil, but takes longer (15–20 minutes).
Cotton seed oil, pure	Black.
Earth nut oil	Brownish red, greenish as it loses in transparency.
Sesame oil	Dark reddish brown, not changing to green.
Rape seed oil	Greenish yellow, then opaque.
Poppy seed oil	Same as preceding.

R. Brulle states that with practice it is possible to determine in many cases thus colorimetrically 5 to 10 per cent of one of these oils in a mixture.

In the same way natural butter, which gives no change, may be distinguished from artificial butter, the latter, owing to the presence of margarine, acquiring a brick red color, and the proportions in a mixture may be approximately determined.—*Compt. Rend.*

N. W. AYER & SON, the Philadelphia advertising agents, use the following appropriate line for their motto: "Keeping everlastingly at it brings success."

Irrigating Arid Lands in the West.

The many thousands of square miles of land in the western half of the United States which can be profitably cultivated only with the aid of some system of irrigation are now becoming more and more each year the subject of careful investigation, both by the government and by private parties. So much of the readily available and ordinarily good farm lands of the public domain has already been taken up that prospectors in almost every section are finding their choice limited to making a selection in some place where more or less irrigation will be a necessity, with the promise of a good reward therefor, or the acceptance of a location where the disadvantages more than outweigh the want of a sufficient amount of water. The wonderfully productive lands of Southern California, where the rich soil is of such depth as to be deemed practically inexhaustible, and the climate is such that two and even three crops can be raised in a year, have been made available almost exclusively by irrigation, and there is no doubt that, over a large portion of the lands now arid, it needs but the efficient conservation and distribution of water flowing from adjacent mountain ranges to create areas of the highest productiveness.

With the view of promoting intelligent work on a general system, this matter has formed the subject of extended investigations by the United States Geological Survey, although it is not proposed that the government shall undertake to carry out irrigation projects at the public expense, further than by the allotment of lands which may be benefited thereby to the State governments making such improvements. A recent bulletin of the census office also gives details of what has been effected in the way of irrigation in Utah, where the system was first generally applied and has been longest in operation. In that Territory there was last year in crop an irrigated acreage of 263,473, about nine-tenths of the farms in the Territory depending upon irrigation in the cultivation of at least a portion of their land, the remaining tenth being either stock ranches or farms where the climate is less arid.

The average first cost of bringing the water to land in Utah is placed at $10.55 per acre, considerably greater than has been the case in most other localities, as the canals and ditches were generally laid out and made by farmers, without the use of surveying instruments, necessitating many subsequent changes. In some cases, however, the cost was below fifty cents an acre. In addition, a certain amount must be expended each year in maintaining the main ditches, cleaning out sediment, and often in renewing the dams and head works, this cost ranging from twenty-five cents up to three dollars an acre, the average being ninety-one cents. The average value of the products on small irrigated farms in 1889 was $19 per acre. It is estimated that the cost of preparing wild land for cultivation, including plowing, grubbing, cutting brush, fencing and leveling, averages $14.85 per acre; adding to this the Government rate of $1.25 per acre, and the first cost of $10.55 per acre for the water right, the entire cost to the farmer averages $26.65 per acre. In comparison with this, the estimated present value of the farms of the Territory, including buildings, fences and other improvements, is placed at an average of $84.25 per acre, showing an apparent profit, less cost of buildings, of $57.60 per acre.

From the main canals or large ditches the water is conducted to the farms by small laterals, and is commonly distributed in three ways—by flooding, by furrows, and by markings. Hay and other forage crops are flooded, the water being allowed to enter the field at its highest point, and find its way if possible in a thin sheet over the whole field. This method requires the greatest amount of water, and cannot always be used on account of the tendency of some soils to bake and form a hard crust. Potatoes, corn, vegetables, and all plants growing in hills or rows are irrigated by furrows, the water flowing therein gradually moistening the ground on either side. Grain is sometimes watered by flooding, but generally by marking off the ground, after the grain is planted the fields being sometimes rolled with a roller having annular projections, which make small grooves in the surface of the ground in such direction that there is a constant and gradual flow from one end to the other.

The use of flowing wells for the irrigation of gardens, orchards, and vineyards, and for domestic supply and watering stock, is also a feature of some importance in Utah. There are 2,524 of these wells, of which the census enumerators obtained particulars concerning 897, showing their average depth to be 145½ feet, and their cost $77.60 each, or 53 cents per foot. Their average diameter was about 2 inches, the flow of water averaging 26·37 gallons per minute.

The carrying out of any general scheme of irrigation necessarily involves considerations which have had but little influence thus far in Utah, where there is already more land under cultivation than there is water available to mature the crops in all years. Some large reservoir sites have been examined and segregated by the Government Geological Survey, with the view to most efficiently and at a moderate expense impounding the flow from elevated areas, the water thus collected to be supplied to large sections by a series of canals on different levels. Considerable work of this kind has already been carried out in California, where the returns generally show ample profit on the outlay, but the large areas of the country which invite this method of cultivation, with abundant promise of yielding large results, have hardly as yet been touched. For this task, simple farmers' ditches are totally inadequate, but competent engineering skill must be called upon to collect and distribute a material proportion of the immense supplies of hitherto unused water often coursing in destructive floods from our great Western mountain system.

The Belgian Firearms Industry.

In the course of a report on the trade of Belgium in 1890, Consul-General De Courcy-Perry remarks that the most important industry of Liege is the manufacture of firearms. There are over 180 gunmakers in the town alone, and in the district the industry gives employment to more than 40,000 workmen. The peculiarity of the Liege gun making is that there are hardly any manufactories, as we understand the term, the various component parts of the firearms being made by the workmen at their own homes and brought in ready-made to the gunmaker, who thus merely requires premises for finishing and storing the arms. It will be at once seen how the economy realized by no extensive plant nor costly workshops being required enables the Liege maker to compete favorably with the manufacturers in, in this respect, less favored countries.

The Liege proofhouse, which is a government institution, is the oldest and by far the largest in Europe, and probably in the world, and has lately been greatly enlarged and improved. Every firearm manufactured in Belgium has to be proved at the Liege proof-house before it is allowed to be sold (with the exception of certain arms that are allowed to be sent to a recognized proof-house, to Birmingham, for instance, to be proved), and the proofmaster, in addition to his ordinary duties, is specially delegated by the government to inspect and control all firearms made in the kingdom, with the exception of the military rifles made at the government factories, which do not pass the Liege proof-house. Every double-barreled rifle and shotgun has to be proved three times. First, each barrel separately; secondly, the two barrels when soldered together; and, finally, after the breech-action has been attached; and the charge of powder employed is considerably more powerful than that used at other proof-houses.

One of the great advantages arising from this triple proof is that each class of workmen has a direct incentive to only turn out, or accept, really reliable material, for no one who has worked upon the gun is paid for his labor unless the arm passes the three proofs satisfactorily. Thus, if the barrels burst at the first proof (viz., that of each barrel separately), the barrel maker loses the cost of his labor and material, for he is obliged to replace the burst barrels without any indemnity. Should the barrels burst at the second proof, it is not the barrel maker alone who suffers, but the solderer as well, who also loses the price of his labor, because he had not examined the pair of barrels carefully enough before working on them. If the gun bursts at the third proof, all those who have worked upon the gun, from the barrel maker upward, lose the benefit of their labor; and thus, as I have said, each class of workmen has a direct personal incentive to turn out a really reliable gun. Revolvers are only proved once, but each portion of the pistol is subjected to a rigorous examination, and any defective arm is at once rejected.

There are in Europe five proof-houses, viz., Birmingham, London; St. Etienne, in France; Fellah, in Austria; and Liege; but none of the others can at all compare in importance with the last, which consumes annually from 3,000,000 to 4,000,000 cartridges and over 40 tons of gunpowder.

Liege exported in 1889 firearms to the value of 724,440*l.*, being 233,944*l.* in excess of the amount of those exported the previous year; and the importance of the Liege gun trade, as compared with that of England and France, will be apparent from the following table of comparison of the arms proved at Liege, Birmingham, and St. Etienne respectively:

FIREARMS PROVED IN 1889.

Firearms.	Liege.	Birmingham.	St. Etienne.
Single barrel	338,024	28,146	4,352
Double barrel	233,526	284,247	32,204
Cheap single barrel for exportation	34,557	155,379	—
Horse pistols (per pair)	20,070	3,481	1,033
Pocket pistols	13,907	—	—
Revolvers	452,098	29,850	3,152
Military rifles and barrels	32,249	28,245	—
Totals	1,124,431	529,048	40,741

It will thus be seen that the firearms proved at Liege amount to more than double those proved at Birmingham, and to nearly double those of Birmingham and St. Etienne together; and I anticipate, so great has been the increase during the past year, that when the figures are published, the firearms proved at Liege during 1890 will be found to amount to over 2,000,000.

PHOTOGRAPHIC NOTES.

Improvements in the Soda Developer.—A number of experiments conducted by the editor of the *British Journal of Photography* show that the addition of chloride of ammonia to the ordinary carbonate of soda and pyro developer will prevent the yellow staining of the negative, in fact acts as a substitute for sodium sulphite. The strength of the carbonate of soda solution is 15 grains to each ounce of water, even 12 grains to the ounce will do, to which is added 4 grains of chloride of ammonia. In mixing the developer a few minims of this solution, say 20 minims to 2 ounces of a pyro or eikonogen solution, will be sufficient, or more may be added to hasten development if needed. In some cases, it is advisable to add a half grain to the ounce of bromide of ammonium.

It is said to work well in connection with hydroquinone, but sulphite of soda should be present to prevent a slight yellow stain that is liable to occur.

Another modification is the use of caustic soda or potash.

The developer as applied to the plate is prepared as follows:

Pyro	6 grains.
Sulphite of soda	20 "
Caustic soda	6 "
or	
Caustic potash	8 "
Chloride of ammonia	8 "
Water	2 oz.

To each ounce of solution one grain of bromide of ammonium should be added.

A Few Improved Developers.—From the *British Journal of Photography* we take the following formulas: *The Paramidophenol Developer*, recommended as being energetic, keeps well and does not stain the film, introduced by A. & L. Lumiere.

Water	1000 parts.
Sodium sulphite	200 "
Sodium carbonate	100 "
Paramidophenol	12 "

Another combination is—

Water	1000 parts.
Sodium sulphite	200 "
Carbonate of litmus	12 "
Paramidophenol	12 "

The latter form is preferred. The developer is on the eikonogen order.

Mixed Eikonogen and Hydroquinone Developer.—M. Angerer, after numerous experiments, suggests the following proportions as giving excellent results:

Solution A.

Water	1250 parts.
Sodium sulphite	150 "
Eikonogen	22½ "
Hydroquinone	7½ "

Solution B.

Water	250 parts.
Carbonate of potash	75 "

For use mix one part of solution B with five parts of solution A. If over-exposure is suspected, use less of B. Negatives of any desired density can be had with this developer, made on fast plates.

Direct Platinotype Printing Process.—Invented by Herr Wischeropp. The main point is to use a chemically pure solution of an iron salt, and to dry it on the paper so quickly that it cannot penetrate to any appreciable depth. To effect this, the paper is hung up to dry in a box at a temperature of 56° C. for two minutes. The solutions employed are:

A.

Sodium ferrous oxalate	40 parts.
Sodium oxalate three per cent	100 "
Chlorate of potassium	0·1 "

B.

Distilled water	60 parts.
Potassium platino-chloride	10 "

In A, the solutions which Pizzighelli keeps separate are combined and the useless glycerine omitted.

Solution A requires to be renewed frequently, but B will keep for any length of time. To produce a good effect, the paper, after having been dried, should be kept in the dark room for some time. The more quickly the printing is done, the better the tones obtained.

Danger of Poisoned Fish.

The *Lancet* contains a warning against the use of iced fish. Ice spoils the freshness, firmness, and flavor of fish by rendering it, prior to putrefaction, insipid, soft, and flabby. Where fish is preserved on ice, it appears that the ice only favors putrefaction by furnishing a constant supply of moisture, carrying with it the putrefactive bacteria derived from its unclean surroundings, so that this iced fish remains covered with fresh solutions of filth pregnant with putrefactive bacteria. On the other hand, keeping fish dry and cold can in no way favor putrefaction.

A Great Blast.

A great blast was to have taken place at Mr. P. Callanan's quarries, at South Bethlehem, N. Y., on June 16, but it failed, owing to imperfections in the electric wiring, and was a disappointment to thousands of people who had congregated to witness the explosion, and to many who expected to note some important results from the method employed in charging. The failure was due solely to the inefficiency of the electrician who had charge of the wiring, and the greatest sympathy was felt by all with Mr. Callanan, who had spared no pains nor expense to make the occasion successful and impressive.

The quarries are situated at an angle in the great limestone ridge which passes through this section. Previous excavation has given the quarry a very uniform face, crescent shaped, and about 400 feet long, with a perpendicular height of 100 feet. About 60 feet from the base of the cliff is a ledge or offset, so that the top of the cliff is set back some 20 feet. The blast holes were drilled on the ledge and at the top, being at an average distance of 18 feet back of the face. The holes were drilled to a depth of 26 feet, and were charged with from 30 to 60 pounds each of 75 per cent "miner's friend" dynamite. The entire charge amounted to 5,000 pounds of dynamite, divided between 132 holes.

The circuit was connected with a dynamo situated in the crushing mill, close to the quarry. At 4 o'clock, in the presence of Governor Hill and his staff and about 5,000 spectators, Mr. Callanan's pretty daughter turned the switch, without result, as the wires were somewhere grounded. Mr. Callanan, however, succeeded in connecting up three sections of his blast, discharging them separately at intervals of 15 or 20 minutes by a hand battery.

At the second discharge the entire cliff, 300 feet long and 75 feet high, was seen to fall over to an angle of 45 degrees, and then drop, completely crumbled.

The American Petroleum Industry.

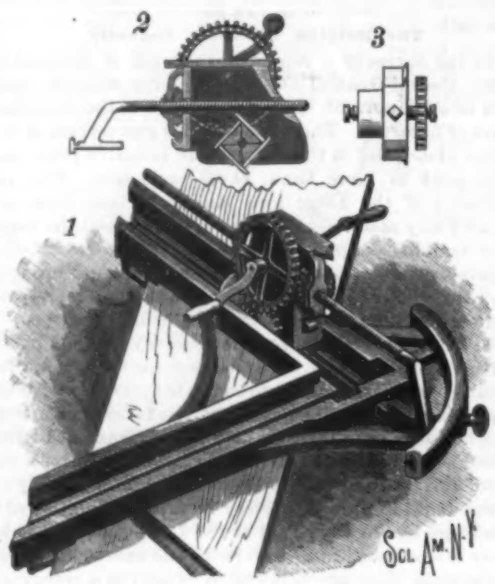
Bulletin No. 76, on the production of petroleum, has been prepared by Mr. Jos. D. Weeks, special agent in charge of statistics relating to petroleum and natural gas, under the supervision of Dr. David T. Day, special agent in charge of the Division of Mines and Mining, of the Census Office. The statistics show that petroleum was produced in eleven States in 1889. The total production is shown to be 34,820,306 barrels, of 42 gallons each, valued at $26,554,052, as follows:

	Barrels.
Pennsylvania and New York	21,486,408
Ohio	12,471,965
West Virginia	358,269
Colorado	316,476
California	147,027
Indiana	33,758
Kentucky	5,400
Illinois	1,460
Kansas	500
Texas	48
	34,820,306

Mr. Robert P. Porter, Superintendent of Census, says that the returns show that of the total product of petroleum, 109,891 barrels were disposed of for lubricating, 12,330,813 for fuel, and 22,379,602 for illuminating purposes. Nearly the entire amount produced in California, Indiana, and Ohio was used for fuel, while nearly the entire amount produced in Colorado, New York, Pennsylvania, and West Virginia was used for illuminating purposes.

AN IMPROVED MORTISING MACHINE.

A portable machine especially adapted for mortising wall strings to receive the risers and treads of steps is shown in the accompanying illustration, and has been patented by Mr. Paul Swieter, of No. 24 Howard Street, Allegheny, Pa. Fig. 1 is a perspective view of the machine, Fig. 2 representing a vertical section through the carriage, while Fig. 3 shows the cutter detached. The base of the machine consists of two parallel angular sections, the members of which are at a right angle to each other, and each of which has a lower horizontal slotted flange, and also an undercut T shaped recess. Opposite the angle of the outside section a segmental plate is secured by radial arms, the plate having a T shaped undercut recess and a downwardly extending central lug through which a set screw passes. The members of the two sections are united by diagonally located connecting plates, by means of adjustable bolts extending up through the slots of the base flanges, whereby the width of space between the sections may be regulated, and in operation the base is attached to the wall string by bringing one side edge of the connecting plates against a face of the string piece and causing the set screw of the segmental plate to engage the other side edge. The carriage is adapted to travel in the space between the sections, and consists of a box-like casing, through which passes the feed screw, having a downward and outward extremity terminating in a horizontal foot, with a button at one end adapted to enter the undercut recess of the segmental plate. At one end of the casing is a vertical bracket, and in the bracket and an aperture in the end of the casing is the hub of a pinion, the bore of the hub being threaded and the pinion turning upon the feed screw. On a shaft near the top of the casing is journaled a crown wheel meshing with the pinion, the shaft being rotated by a crank arm on each side, the crown wheel also, through connecting gears, operating the cutters, which revolve between the sides of the casing in its lower open face. The cutter head is made in two sections, one of which is nominally fixed and the other held to slide, producing a mortise cut of any desired width, or such adjustment may be made that the mortise will be wider at one end than it is at the other. When one mortise groove or channel has been completed, the position of the carriage is reversed, it being then placed

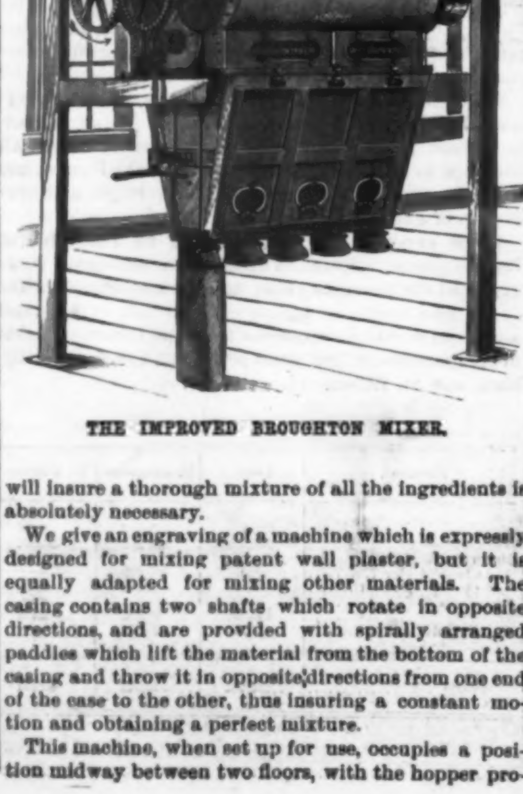


SWIETER'S MORTISING MACHINE.

at the other channel of the base, the foot of the feed screw being correspondingly adjusted in the segmental plate.

IMPROVED MECHANICAL MIXER.

In the preparation of many plastic materials, such as wall plaster, cements, paints and the like, nearly or quite as much depends upon the manner in which the materials are put together and mixed as upon the materials themselves. To secure perfect homogeneity in certain kinds of cements, a peculiar handling which



THE IMPROVED BROUGHTON MIXER.

will insure a thorough mixture of all the ingredients is absolutely necessary.

We give an engraving of a machine which is expressly designed for mixing patent wall plaster, but it is equally adapted for mixing other materials. The casing contains two shafts which rotate in opposite directions, and are provided with spirally arranged paddles which lift the material from the bottom of the casing and throw it in opposite directions from one end of the case to the other, thus insuring a constant motion and obtaining a perfect mixture.

This machine, when set up for use, occupies a position midway between two floors, with the hopper projecting through the floor above, and discharge spouts held at a convenient height for supporting the bags into which the material is discharged from the machine. The hopper is provided with a pair of iron doors which open downward to let the material into the mixing chamber. These doors are attached to shafts which are provided with worm wheels engaged by a worm which is readily operated by a hand wheel on the floor above at the side of the hopper.

After the material is mixed by the spirally arranged paddles, it is dropped into a receiving chamber below by means of sliding doors, which are furnished with shearing edges adapted to cut off anything of a fibrous nature which may be in the plaster, thus insuring a perfect closing of the doors. The receiving chamber is furnished with valves which control the discharge through the spouts to which the bags are attached.

The machine has a capacity of 200 barrels a day of ten hours, requiring only two men to work it, but its capacity can be increased by providing more laborers. No time is lost in operating the machine, for while one charge is being bagged, another is undergoing the operation of mixing, and at the same time the hopper above is being charged, so that really there are three charges in the machine at one time. The machine is arranged to run at a high speed; its shafts are journaled in boxes outside the casing, and stuffing boxes are provided for preventing the escape of the material around the shafts. The high speed and construction of paddles renders it a perfect mixer of hair and fiber with plaster.

This machine is manufactured by Mr. W. D. Dunning, Syracuse, New York.

Extraordinary Increase in the Wheat Trade of Bombay.

The Bombay papers received by the last mail describe the extraordinary export of wheat from that port during the past few weeks. The *Times of India* says that every warehouse near the docks and every available piece of open ground were occupied by towering tiers of bags filled with grain, awaiting the arrival of ships to take it away to other ports, where abnormal prices have been paid for it, and where its arrival is eagerly awaited.

In 1874 the total shipments of wheat from Bombay were 33,071 tons, while in 1886 the figures went up to 617,834 tons, this being the largest total shipped up to the present year. But never since 1874, the year when the wheat trade practically began, have the receipts of wheat in Bombay been so large, or nearly so large, as in the first four months of the current year. They reached during that period the enormous total of 198,097 tons, as compared with 97,420 tons in the corresponding four months of the previous year, and 178,686 tons in the same period of 1886. Steamers representing a total carrying capacity of between 350,000 tons and 400,000 tons were expected to load in Bombay in the course of the present month, and in spite of this large carrying accommodation it will be no easy matter to get the bags, or, at least, those that are not under cover, shipped before the rains. The receipts continue to be so great that as fast as the ground is cleared of one consignment it is occupied by another. The real cause of this unprecedented traffic is the damage sustained by the French wheat crop, which is likely to be about 25 per cent under the average. The traffic over the different railway systems terminating in Bombay has been gigantic during the past few months.

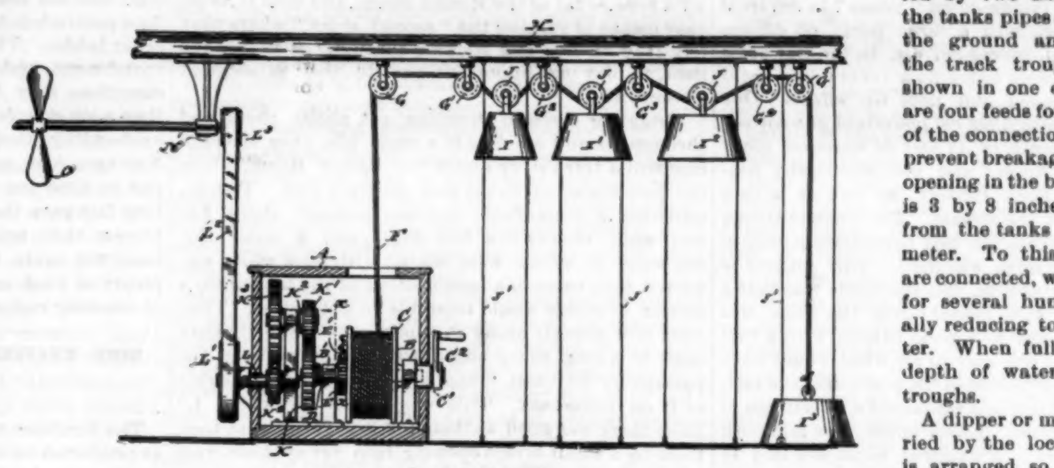
As recently as 1876 wheat was rotting in the Central Provinces, which is now regarded as the granary of India, on account of want of transport, but owing to the railway extensions carried out since that time—the through route to Calcutta being one of the most important—the number of growers has increased materially, and it is now worth their while to produce grain extensively. The lines have been overcrowded with grain, the receipts in Bombay being so vast that the greatest difficulty is experienced in finding warehouse accommodation for the hundreds of tons which are daily brought in from up country. Indeed, the competition for accommodation is so great that the rentals have gone up to more than 100 per cent beyond the ordinary charges. The price of labor and cost of carting have also increased.

Preparation of Lubricants.

The soap formed by treating wool grease with alkaline lye is dissolved in water and filtered. To this a solution of alum or other alumina salt is added, whereby a brown precipitate is formed, which is called "aluminum-lanolate." With this substance, when dried, lubricating oils of any viscosity may be produced by dissolving it in any fluid mineral oil. If dissolved in a small quantity of mineral oil, a gelatinous substance is obtained which may with advantage be mixed with India rubber or gutta-percha. Solvents for India rubber are said to be also solvents for "aluminum-lanolate." In textile industries this substance may also be used as a scouring agent.—*R. Krause, Wittenberg, Prussia.*

A WEIGHT POWER TO DRIVE FANS, ETC.

The illustration represents a device of simple construction designed to be utilized in driving fans, sewing machines, small pumps, and other light machinery. It has been patented by Mr. Louis Dedel, of No. 245 Josephine Street, New Orleans, La. In the casing, A, is supported a drum, C, on a shaft, D, the shaft being connected with the drum by a ratchet mechanism, the ratchet wheel being engaged by a spring-pressed pawl when the drum turns in one direction, while the pawl passes over the teeth of the ratchet when the drum turns in the opposite direction. On the drum is wound a rope, F, extending up over a series of pulleys, G, on the ceiling, H, there being hung on the rope between adjacent pulleys a series of weights, I, the last of which, I^2, is attached to the free end of the rope. The weights slide along suitable guideways, J^1, extending from the ceiling to the floor, and increase in size and weight in such manner that the last weight is sufficiently heavy to hold the other three weights in an uppermost position, the third weight in like manner holding up the other two, and the second weight holding up the first, each, however, developing surplus power to actuate the drum. A series of gear wheels, K, connected with the drum shaft, actuate shaft, L, extending to the outside of the casing, this shaft carrying a pulley connected by a belt with the mechanism to be driven, in the illustration represented by a fan. On the outer end of the hub of the drum is a crank arm, C^2, to wind up the rope of the drum, by which all the weights are raised to an uppermost position, the drum shaft then remaining motionless as the pawl glides backward over the ratchet teeth. By using an additional set of weights, with proper connections, this power may be made to operate without interruption, one set of weights being wound up as the other runs down.



DEDEL'S WEIGHT POWER.

Detection of Paraffin in Beeswax.

A few grammes of the substance in fine air-dried shavings are gradually heated in a small porcelain capsule until fumes begin to rise. A half-liter wide-mouthed bottle is then inverted upon the capsule, and when filled with white vapors is closed and set aside until the fumes have condensed upon its walls. The sublimate is then dissolved in 3 c. c. of chloroform, the chloroform evaporated in a test tube, and the residue boiled with 4 c. c. of soda solution. If paraffin was present, it will, after cooling, be found floating on the clear solution. A drop of the chloroform solution may also be evaporated on a slip of glass and examined microscopically.

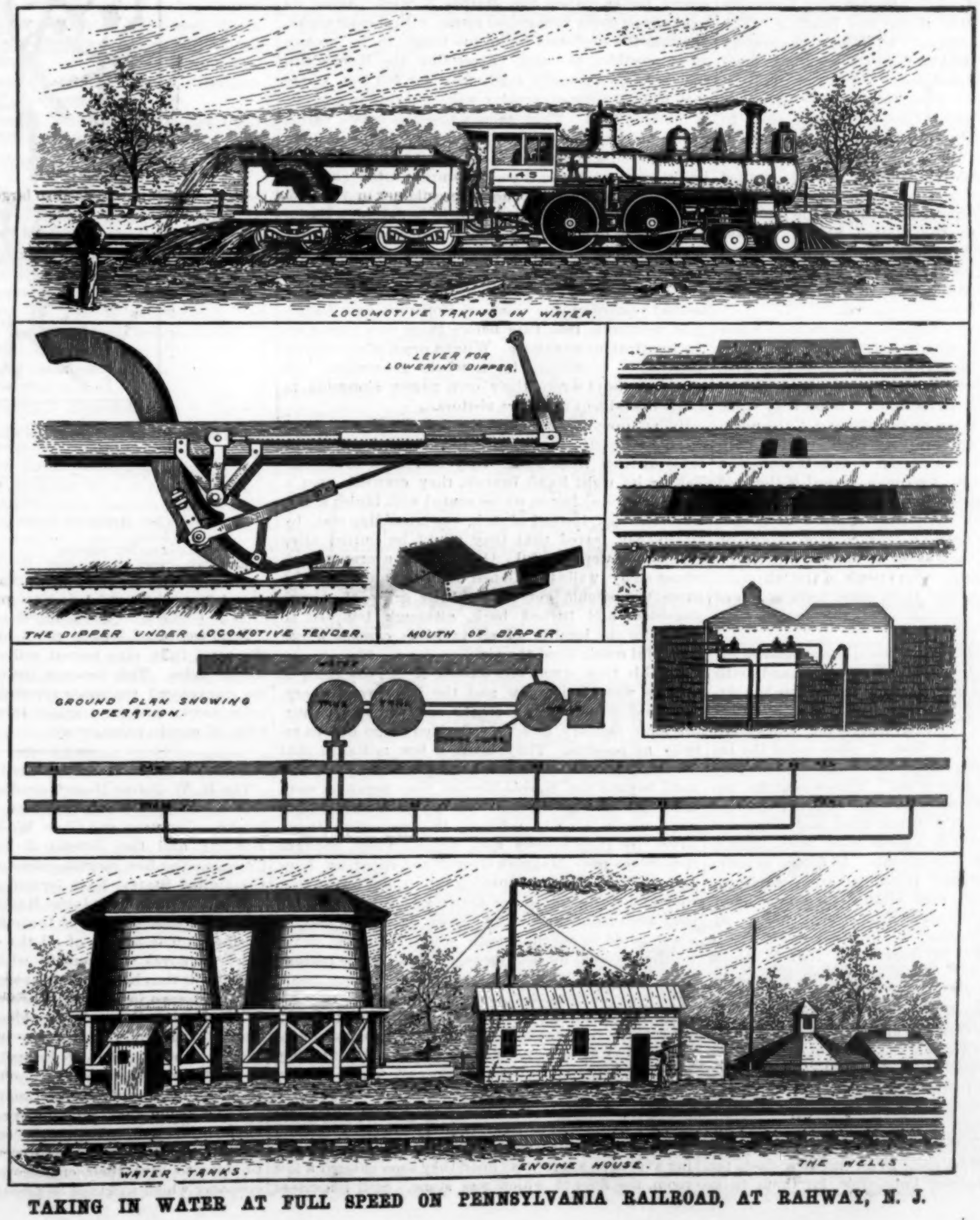
The fumes from pure beeswax are not so white as from paraffin, and are only obtained at a higher temperature (300°—320°). The sublimate gives a colored solution with chloroform and a colored and turbid solution with soda. The residue from the chloroform solution is a dull film; paraffin, on the contrary, gives separate grains in a clear field.

SUPPLYING MOVING TRAINS WITH WATER.

The system of taking water into locomotive tender water tanks without stopping the train has been quite extensively introduced upon some of the leading railroads of this country. A good example is now in operation upon the Pennsylvania Railroad about one mile east of Rahway, N. J. An iron trough is laid upon the sleepers. It is 6 inches deep, 18 inches wide, and about 1,200 feet long. It is made in sections 30 feet long, or just the length of a rail. Two drilled wells supply the water, which is pumped from water vaults or cisterns over the wells into elevated tanks by the side of the track. The tanks, of 35,000 gallons capacity each, are fed by two Blake pumps. From the tanks pipes are carried down to the ground and underground to the track trough, entering it as shown in one of the cuts. There are four feeds for each trough. Part of the connections are of leather, to prevent breakage by jarring. Each opening in the bottom of the trough is 3 by 8 inches. The first pipe from the tanks is 12 inches in diameter. To this two 8 inch pipes are connected, which run both ways for several hundred feet, eventually reducing to 4 inches in diameter. When fully charged, 5 inches depth of water are run into the troughs.

A dipper or movable chute is carried by the locomotive tender. It is arranged so as to be raised or lowered at will by a lever. The general construction is shown in the cut. When lowered, it descends to within about one inch of the bottom of the water trough. From the mouth of the dipper a rectangular pipe rises into the water tank of the tender. At its upper end this pipe is one foot square. The range of vertical movement of the dipper is about eight inches. Its mouth is three and one-half inches high, and corresponds closely in width with the interior of the trough. It is made of copper, so that if it strikes anything it will bend and not break, and can be easily straightened out again. A wing or blade extends over the top of the mouth, to prevent water being thrown over and out of it.

To take in water the fireman lowers the dipper. As it meets the water in the tank, the latter is forced up in great volumes into the tender tank. From one trough two thousand two hundred gallons can be taken in on passing. A watering station is installed about every forty miles. Thus an engine can run continuously as far as the coal can carry it on a road supplied with these appliances.



TAKING IN WATER AT FULL SPEED ON PENNSYLVANIA RAILROAD, AT RAHWAY, N. J.

Survey of the Pacific Coast.

After nineteen years the United States steamer Hassler has completed the survey of the California and Oregon coasts. The Hassler was built specially for this work in 1871, and on her maiden trip around Cape Horn, Professor Agassiz made a series of deep-sea dredgings along the coast of North and South America, with valuable results to science. The most interesting fact developed in the recent surveys is that the coast line of Southern California is more abrupt than that of any part of the Atlantic or other portion of the Pacific.

Electricity in Warfare.

Some interesting experiments have been made in the estuary of the Mersey to test the efficacy of submarine mines as defenses of the approaches to the port of Liverpool. For some days the Mersey Volunteer Division R.E., Major Montgomery commanding, devoted themselves to laying down "mines" in different spots, and the major, with a large party of officers and others interested, proceeded out in the war office steamer Lady Heathfield to see how these mines could be electrically exploded and note the effects. One mine (an iron box containing 100 pounds of gun cotton) had been laid at a depth of 15 feet of water off rocks known as the "Red Noses," and was electrically connected with Perch Rock Battery, as well as with a buoy 200 yards out in the stream. The steamer struck against this buoy, an electric bell immediately rang in the battery, and the mine was fired. This seemed to be practically instantaneous, and the result was that a rudely constructed raft placed over the mine was hurled up in fragments to a great height, with a vast volume of water. It was easy to see what would have been the fate of a ship placed in the position of the raft, especially if the iron box had contained a full charge of 500 pounds of gun cotton. Lesser mines were laid with relatively equal effects. A hundred mines are laid in the Mersey as port defenses.

The Mammoth Cave of Indiana.

BY H. C. HOVEY.

Rummaging lately among the rare and curious books in the library of Colonel Durrett, I found proof that while Gen. W. H. Harrison was territorial governor he visited, in 1806, a remarkable excavation which he styled "The Mammoth Cave of Indiana." Later in the same year was discovered its famous and only rival, "The Mammoth Cave of Kentucky." But the Hoosier cave has plainly the prior right to the unique title, only it is now too late to make the assertion except as a matter of curious interest. The earliest published account appears in Martin's "Sketches of Louisville and its Environs" (1819), under the heading "The Mammoth Cave of Indiana." In Flint's Geography (1831), it is called the "Epsom Salts Cave," and in legal enactments in 1843 it is designated "The Indiana Saltpeter Cave," a name now given to a smaller cave near by. The name "Wyandot Cave" does not seem to have been adopted until about 1848, being taken from the adjacent Wyandot River, now known as the Blue River. At an early day the ground was pre-empted by Dr. B. Adams, who had saltpeter works here from 1812 to 1819, when, by his failure to pay the purchase money, it reverted to the United States. It was bought in 1820 by Mr. Henry P. Rothrock, who at a later date perfected his title, and by whose will it becomes, under certain conditions, the heritage of Mr. Frank Rothrock, his favorite grandson.

Frank Rothrock, with a commendable desire to know as much as possible about his prospective domain, recently organized an exploring party, including with himself three other sturdy lads named Ben Hains, Henry McClintick and Ira Rainbolt. What they style, in their narration placed at my disposal, "the unexplored regions," are not properly such, having been visited in 1860 by Messrs. Andrew and Washington Rothrock, together with two men named Miller and Langsdale. Miller gave out at a place called for that reason Miller's Reach. Andrew stopped at a spot known as Andrew's Retreat. Washington Rothrock and Mr. Langsdale went as far as Langsdale's Basin. But such are the difficulties and perils of the labyrinth that no one has ventured there since, until now, nor has any previous description of the region been published.

The general plan of the cave resembles a gigantic letter K, including the main cave and the north and south arms. Twelve hours are required to traverse the sixteen miles ordinarily on exhibition. The so-called "unexplored regions" cover at least seven miles additional. They are entered from a place called the Ice House, because the gypsum-coated blocks of limestone resemble so many masses of ice. This is near the termination of the northern arm. The boys dived under a ledge but two feet above the floor, and burrowed through what resembled a great snow bank, though really a mass of sparkling crystals. In fifteen minutes they came to the Round Room, out from which ran several short branches, each ending in a mud bank. But through an orifice eight feet overhead, they entered a sort of second story, or in other words a cross cave. For it should be understood that Wyandot Cave, instead of being a single excavation, is made up of numerous different caverns connected with each other by large or small openings. Going northward over cliffs, through crevices, and sliding along sharp ridges, the boys halted on the edge of a pit, which they contrived to cross by a kind of natural bridge, and went 300 yards further, finding many oulophilites and other ornate forms of alabaster. In a circular room, 10 feet high and 60 wide, were remarkably fine helictites, as well as straight stalactites. Their explorations in this direction came to an end at a deep pit, beyond which it seemed impossible for them to go without appliances with which they were not furnished at the time.

On a subsequent trip they took along a rude ladder made from a cedar tree, the trunk of which was about three inches in diameter, the boughs being cut at a convenient length for climbing. This they dragged in by a rope as far as the Round Room, and used it as an easy means of gaining the "second story," where they left it with one end sticking through the hole in the floor, to play an important part in their subsequent adventures.

Wriggling through an orifice, yet above them, and through narrow crevices in a rocky pile, they emerged into still a third story above the Round Room, where the floor sloped up to the roof on every side. Thence, pursuing a remarkable winding passage, about five feet wide, twenty-five feet high, and a mile long, the walls of which were coated with pure white alabaster, they came to a modification of the labyrinth, a section of which would resemble an hour glass. They were now directly under the main cave. Shortly they came to a long, sharp-edged rock, filling entirely the passage for fifty feet, along which they had to stride as if on horseback. This was "Rode Rock, No. 1." Then there was good walking for 200 yards, that took them to a small orifice opening into yet another cross cave, called the Wild Cat Avenue, a large, low room, with a very muddy floor, on perhaps as low a level as any other spot in the whole cave. Beyond it is Maggie's Grotto, about thirty feet wide. From this they made their way again into the main avenue they had left for this transverse cave, and which bears the name of the Little Giant Avenue.

And now they met with a novel difficulty, for the floor was cut by a series of pits that could be crossed only by bracing themselves against the opposite walls. Coming to a pit too wide to be managed in this way, the boys climbed to the top of the passage, and striding the chasm for half an hour, they finally descended from a rocky shelf to a beautiful stream flowing between snowy banks, called the Marble Rivulet. Along its banks grew many spongoidal forms, with slender necks, but that the explorers found too tough to be broken off by anything at hand. Ascending the Marble Hill they enjoyed a smooth sandy floor for 600 feet, where they walked between creamy walls, curving in and out in rounded lines. Then came a tiresome crawl, varied occasionally by the cavern's suddenly folding in upon itself in such a manner as to compel the poor boys to lie sideways and drag themselves around the sharpest kind of "devil's elbows," as they called them. Striding Rode Rock, No. 2, they came to Langsdale's Basin, a small pool in a room ten feet in diameter. This pool is very shallow and its bottom covered with a fine yellow sediment. Imagine their emotions on seeing written there by the finger, and seeming as fresh as if inscribed yesterday, the names of Rothrock and Langsdale, written in 1860, long before those now gazing on the inscriptions were born. What a proof of absolutely unchanged conditions for a whole generation! Of course the boys wrote their own names alongside to await the advent of future visitors.

By an opening through the left hand wall, and down a steep clay bank, they next entered a spacious cave, distinct from those they had been exploring. Taking its right hand branch, they crawled over a floor resembling frozen waves coated with bluish slime, while the roof, instead of rock, was crumbling clay, by which they feared that they might be buried alive unless they were careful. On reaching a cross trench whose slimy walls threatened to allow no escape for those who should get within their grasp, they were disgusted, and turned back, although tempted to search for the locality of an invisible cascade whose mournful music filled the air.

By this time it was one o'clock A. M., the stock of candles was getting low, and the boys were weary. They had made so many crooks and turns as to overtax their memory, and they decided to go out as rapidly as possible. They made a few mistakes that were easily rectified, and all went smoothly enough until, beyond the Marble Rivulet, they began to work their tedious way through the top of the great hour glass crevice already referred to, supporting themselves by their elbows and knees. They thought themselves near Maggie's Grotto, and spent an hour and a half hunting the opening into it, not aware that they had really passed far above and beyond it. On they went painfully and by a most dangerous path, if a way could be called a path where their feet never touched ground for 400 yards. Presently the passage shrank to a width of six inches, and they could neither go forward nor backward nor upward. Accordingly they tried going downward, with the terrible certainty, however, that, in their exhausted condition, they could never climb up again. Plainly they were lost, and that in a part of the cave where no mortal had ever been before, and where no rescue party would ever find them. The walls closed in so fast around them that in their frantic efforts to descend the rift their coats were torn from their backs. Reaching at length a hard clay floor, they soon entered a low room, the floor of which was stone. Still impressed that their way of deliverance lay through some upward passage, they tested every opening, but in vain. At four A. M. the boys had but one candle apiece, and were many miles from the safe outer world. Round and round they went, examining the walls of their prison house. Finally, in sheer desperation, they tried a pit that led them down to a lower room, from whose floor protruded, to their great surprise, the tip of their cedar ladder. They were in the "second story" of the round room, and two miles nearer the mouth of the cave than they had thought. In five minutes more they were creeping through to the Ice House, whence, husbanding their candles, they hurried down the Northern Arm, and emerged from the cave at 6 A. M., just in time for an early breakfast, for which their long fast gave them a keen appetite. Like brave explorers they announce their intention of taking the same trip again, with a better equipment, rope ladders, plenty of food, and a large supply of candles, in hope of reaching regions far beyond those already visited.

SOME MEASUREMENTS IN THE MAMMOTH CAVE OF INDIANA.

BY H. C. HOVEY.

The localities named will all be found on the map as published by the Indiana State Geological Survey, tenth annual report, but the distances will be found quite different. I am indebted for them to my friend and able assistant, Mr. Ben Hains, of New Albany, Ind., who vouches for their accuracy. The measure-

ments as given are all from the entrance to the points named.

To the	Standing Rocks	440	feet.
"	Scuttle	750	"
"	Cut-off	1,000	"
"	Wolf's Lair, through the Cut-off	1,600	"
"	Delta Island	1,450	"
"	Foot of the Hill Difficulty	2,000	"
"	Auger Hole	2,400	"
"	Slippery Hill	2,700	"
"	Crawfish Spring	4	miles.
"	Pillar of the Constitution, about	2½	"

Total combined length of all exhibited portions of the cave, fully nine honest miles—commonly called sixteen miles. This does not include what are styled the unexplored regions, supposed to be about seven miles more, making a grand total of sixteen actual miles of cavern passageway.

Asbestos Manufacturers Consolidate.

The H. W. Johns Manufacturing Company and the Chalmers-Spence Company, New York; the Asbestos Packing Company and Chas. W. Trainer & Company, Boston; and the Shields & Brown Company of Chicago—the five largest asbestos manufacturers in the United States—have formed a corporation under the name of the H. W. Johns Manufacturing Company. They will control most of the output in their line of business. The officers of all the companies and their chief employes will remain with the new concern, which will thus have the advantage of their combined skill and experience. H. W. Johns is the president; R. H. Martin, formerly president of the Chalmers-Spence Company, the new vice-president; C. H. Patrick, treasurer, and G. P. Erhard, secretary; both of the last two named having previously been with the H. W. Johns Manufacturing Company.

The consolidation, which was effected July 1st, was made, it is stated, to reduce the cost of asbestos manufacture and to save other expenses. The company promise to give their customers the benefit of the economy which will thus be practiced.

Correspondence.

St. Joseph, Missouri.

To the Editor of the Scientific American:

In your list of cities (see SCIENTIFIC AMERICAN of June 13) that are the centers of large populations within a square of fifty miles around them one city was omitted, which must rank next to, if it does not exceed, Pittsburg, and that is St. Joseph, Missouri. Within fifty miles of her is Kansas City, Mo., and Kansas City, Kansas, and this brings the number considerably over six hundred thousand. South of Kansas City the country is not so populous as that around St. Joseph. Large as is this population around St. Joseph, no part of the country is increasing more rapidly.

Oregon, Mo., June 23, 1891. CLARKE IRVINE.

Bursting of an Emery Wheel.

To the Editor of the Scientific American:

There occurred a singular and fatal accident near here recently, in which a prominent and worthy farmer lost his life instantly. Mr. George B. Albertson, of Cook's Valley, was engaged in grinding sickle guards by steam power on an emery stone 12 inches in diameter and 1 inch thick, when the stone burst and a piece in shape like a quadrant, 6 inch radius, buried itself in his head, going down into his neck as far as the collar bone, killing him instantly. It took the combined strength of two men to remove the piece, as it was firmly bedded in his head and neck, nearly out of sight. After the accident the speed at which the stone was running was measured, and it was found to be over 8,000 revolutions per minute. H. B. J.

Wabasha, Minn., June 16, 1891.

An Effective Wash for Orange Scale.

To the Editor of the Scientific American:

I see in your paper of June 20 last an article headed "Condensed Information Concerning the Most Valuable Insecticides," from a circular issued by the United States Agricultural Department. The wash there given for San Jose scale (*Aspidiotus perniciosus*) has long since been abandoned here as not only comparatively worthless, but harmful to the tree, and for fear it might mislead some one I write you.

The horticultural board of this county (Tulare, Cal.) has brought out a wash which is now being used all over the State, and the formula is the following:

Sulphur	20 pounds.
Lime	10 "

Boil for two or three hours in 20 gallons of water until the lime and sulphur have thoroughly united, then add lime enough to make a thin white wash, adding water enough to make 60 gallons. Apply with spray pump warm, and all the scale will be killed and the tree will be invigorated. N. W. MOTHERAL,
Horticultural Commissioner.

Hanford, Cal., June 25, 1891.

A Pest of Snails.

To the Editor of the Scientific American:

I desire information that will aid me in exterminating a species of mammoth snail from my premises. We have been afflicted with them about four years, in a little yard back of our dwelling, 40 × 60 feet, used for cultivating quite a variety of roses and other flowering plants, and have two thrifty grapevines trellised against the back walls.

These snails are found measuring from three to nearly six inches in length and half an inch in diameter. Their slimy iridescent tracks are numerous. Their peregrinations are nocturnal. When I commenced to hunt them in the evening with a lamp, I used to secure sometimes one hundred at a time. I diligently hunted them almost every night during the summers, with hopes of tiring them out. But as time is beginning to tire me out, and the snails hold their own with disgusting pertinacity, I no more waste steps.

Early in the spring they manifest their presence. Our grounds are kept clean and there are no damp or mouldy accumulations on our premises, but adjoining us, over the fence, are rank weeds and, I presume, some careless deposits of rubbish.

What I would particularly desire to know is a method of exterminating the pests—some alkali or astringent that could poison or destroy them on or in the ground. Suggestions and experiments have been utilized to the limit of knowledge, with no relief. If the SCIENTIFIC AMERICAN can offer any device to rid us of this affliction, we will bless it. GEORGE C. ALLIS.

Birmingham, Conn., June 27, 1891.

Reply by Professor C. V. Riley.—The slugs referred to by your correspondent are, from the description, without much question, *Limax flavus*, a well-known pest in European gardens. At least this is the determination given me by Professor William H. Dall, our highest authority on these creatures, for a species which has, during the past three years, been repeatedly sent to me with accounts of its abundance and injuries. They abound most in sheltered, shady, moist situations, and their numbers are easily reduced in our hot summers by avoiding all plank walks and by keeping from the garden all decaying wood or other moist and shade-giving material. Dry, powdery substances, especially those which are pungent, like wood ashes, salt, lime, etc., are antipathetic to and tend to destroy them. Of these different substances lime is the best, because the others are frequently exuviated with the skin. I am not aware just when this species was introduced from Europe, but it has been more than ordinarily common on the Atlantic coast of late years, largely, I think, because of our unusually wet seasons.

Detecting Forgeries on Paper.

Recently before the Belgian Academy of Medicine, Prof. G. Bruylants gave an account of the researches which, in co-operation with Prof. Leon Gody, he had instituted with the view of illustrating how frauds and alterations practiced on business papers can be detected. He said:

Although my experiments were not carried on under the most favorable circumstances, their results were satisfactory. A piece of paper was handed to me for the purpose of determining if part of it had been unequally and greatly wet, and if another part of it had been manipulated for the purpose of erasing marks upon it; in other words, whether this part had been rubbed. The sample I had to work upon had already gone through several experiments. I had remarked that the tint of paper exposed to the vapor of iodine differs from that which this same paper assumes when it has been wet first and dried afterward. In addition to this I realized that when sized and calendered paper, first partially wet and then dried, is subjected to the action of iodine vapor, the parts which had been wet take on a violet tint, while those which had not been moistened became either discolored or brown. The intensity of the coloration naturally varied according to the length of time for which the paper was exposed to the iodine.

There is a very striking difference also when water is sprinkled over the paper, and the drops are left to dry off by themselves in order not to alter the surface of the paper, complete desiccation being produced at a temperature of 212°.

Thorough wetting of the paper will cause the sprinkled parts to turn a heavy violet blue color when exposed to the vapor, while the parts which were untouched by the water will become blue.

If, after sprinkling upon a piece of paper and evaporating the drops thereon, this piece of paper is first thoroughly wet, then dried and subjected to the action of iodine, the traces of the first drops will remain distinguishable whether the paper is dry or wet. In the latter case the traces of the first sprinkling will hardly be distinguishable so long as the moisture is not entirely got rid of, but as soon as complete dryness is effected their outlines, although very faint, will show plainly on the darker ground surrounding the space covered by the first drops.

In this reaction water plays virtually the part of a sympathetic fluid, and tracing the characters with water on sized and calendered paper, the writing will show perfectly plain when the paper is dried and exposed to the action of iodine vapor. The brownish violet shade on a yellowish ground will evolve to a dark blue on a light blue ground after wetting. These characters disappear immediately under the action of sulphurous acid, but will reappear after the first decoloration, provided the paper has not been wet and the decoloration has been effected by the action of sulphurous acid gas.

This process, therefore, affords means for tracing characters which become legible and can be caused to disappear, but at will to reappear again, or which can be used for one time only and be canceled forever afterward.

The usual method of verifying whether paper has been rubbed is to examine it as to its transparency. If the erasure has been so great as to remove a considerable portion of the paper, the erased surface is of greater translucency; but if the erasure has been effected with care, examination close to a light will disclose it, the erased part being duller than the surrounding surface, because of the partial upheaval of the fibers.

If an erasure is effected by means of bread crumbs instead of India rubber, and care is taken to erase in one direction, the change escapes notice, and it is generally impossible to detect it, should the paper thus handled be written upon again.

Iodine vapors, however, show all traces of these manipulations very plainly, giving their location with perfect certainty. The erased surfaces assume a yellow brown or brownish tint. If, after being subjected to the action of the iodine, the paper on which an erasure has been made is wet, it becomes of a blue color, the intensity of which is commensurate with the length of time to which it has been under the action of the iodine, and when the paper is again dried the erased portions are more or less darker than the remainder of the sheet. On the other hand, when the erasure has been so rough as to take off an important part of the material, exposure to iodine, wetting and drying result in less intensity of coloration on the parts erased, because the erasing, in its mechanical action of carrying off parts of the paper removes also parts of the substances —fecula sizing—which in combination with iodine give birth to the blue tint. Consequently the action of the iodine differs according to the extent of the erasure.

When paper is partially erased and wet, as when letters are copied, the same result, although not so striking, follows upon exposing it to the iodine vapor after letting it dry thoroughly.

Iodine affords in certain cases the means of detecting the nature of the substances used for erasing. Bread crumbs or India rubber leave yellow or brownish yellow tints after iodination, and these are distinguished by striæ or more intense coloration, erasure by means of bread crumbs causing the paper to take a violet shade of great uniformity. These peculiarities are due to the upheaval of the fibers, caused by rubbing. In fact, this upheaval creates a larger absorbing surface, and consequently a larger proportion of iodine can cover the rubbed parts than it would if there had been no friction. When paper upon which writing has been traced with a glass rod, the tip of which is perfectly round and smooth, is exposed to iodine vapor, the characters appear brown on yellow ground, which wetting turns to blue. This change also occurs when the paper written upon has been run through a supercalender. If the paper is not wet, these characters can be made to appear or be blotted out by the successive action of sulphurous acid and iodine vapor.

Writing done by means of glass tips will show very little, especially when traced between the lines written in ink. The reaction, however, is of such sensitiveness that where characters have been traced on a piece of paper under others they appear very plainly, although physical examination would fail to reveal their existence, but a somewhat lengthy exposure to iodine vapors will suffice to show them.

If the wrong side of the paper is exposed to the iodine vapor, the characters are visible, but of course in their inverted position.

If the erasure has been so great as to take off a part of the substance of the paper, the reconstruction of the writing, so as to make it legible, may be regarded as impossible: but even in this case subjecting the reverse side of the paper to the influence of the iodine will bring out the reverse outlines of the blotted-out characters so plainly that they can be read, especially if the paper is placed before a mirror. In some instances, when pencil writing has been strong enough, its traces can be reproduced in a letter press by wetting a sheet of sized and calendered paper in the usual way that press copies are taken, placing it on paper saturated with iodine to be reproduced, and putting the two sheets in a letter book under the press, copies being run off as usual in copying letters. The operation, however, must be very rapidly carried out to be successful. As a matter of fact, the certainty of these reactions depends entirely upon the class of paper used. Paper lightly sized or poorly calendered will not show them, while manipulations of which I think description would be rather superfluous here can interfere very materially with the results mentioned above.

Another point consists in knowing how long paper will retain these reactive properties. In my own experiments the fact has been demonstrated that irregular wetting and rubbing three months old can be plainly shown, as after this lapse of time characters traced with glass rod tips could be made conspicuous. I have noticed that immersing the written paper in a water bath for three to six hours will secure better reactions, but although these reactions are very characteristic, they are considerably weaker.

Antidote for Snake Bites.

An interesting illustration of the antagonistic action of poisons is mentioned in the current number of the *Pharmaceutical Journal.* Dr. Mueller, of Yackandandah, Victoria, has written a letter in which he states, says our contemporary, that in cases of snake bite he is using a solution of nitrate of strychnine in 240 parts of water mixed with a little glycerine. Twenty minims of this solution are injected in the usual manner of a hypodermic injection, and the frequency of repetition depends upon the symptoms being more or less threatening, say from 10 to 20 minutes. When all symptoms have disappeared, the first independent action of the strychnine is shown by slight muscular spasms, and then the injections must be discontinued unless after a time the snake poison reasserts itself. The quantity of strychnine required in some cases has amounted to a grain or more within a few hours. Both poisons are thoroughly antagonistic, and no hesitation need be felt in pushing the use of the drug to quantities that would be fatal in the absence of snake poison. Out of about 100 cases treated by this method, some of them at the point of death, there has been but one failure, and that arose from the injections being discontinued after 1½ grains of strychnine had been injected. Any part of the body will do for the injections, but Dr. Mueller is in the habit of making them in the neighborhood of the bitten part or directly upon it.

EDISON DYNAMO AND MOTOR.

(Continued from first page.)

allows of the renewal of the oil. The bearings at opposite ends of the machine are alike, except that the cast iron support of the bronze journal box, at the commutator end of the armature, is turned on its inner end to receive the brush yoke.

(To be continued.)

How to Protect Sun-Dried Brick Walls.

A missionary in Africa writes as follows in *Regions Beyond*:

"When we came to Lolongo, the first permanent building we attempted was of clay with a palm leaf roof, but before it was finished we found that far more time, trouble, and attention was needed for this kind of house than for one of brick. I am now firmly convinced, from experience, that to put up clay buildings is a great waste of strength and energy. Personally, I have resolved never again to attempt them.

"I am now writing this within comfortable brick walls, but before we could enjoy these we were obliged to exercise patience till a sufficient number of bricks were ready with which to start building. With bricks in readiness, a house like this could be easily erected and made fit for habitation in three months.

"Now these bricks are only sun-dried, and, where exposed, would suffer very considerably from the effects of tornadoes, were it not that we have discovered a means by which to protect them from wind and rain. The walls outside are plastered with a preparation of river sand and clay to the height of 4½ feet, but this would be little better than useless were it not painted with palm oil, which renders the surface impervious to water. Several months of experience have proved that the use of this simple discovery renders the plaster of which I speak almost as hard and as serviceable as English cement."

Stephen Grey, the Founder of Electrical Science.

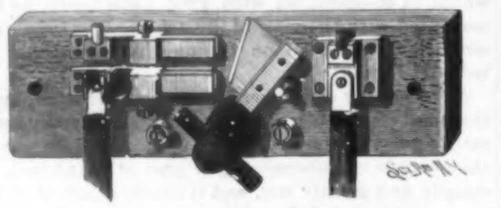
A. D. 1720.—Grey, or Gray (Stephen), a pensioner of the Charter House and Fellow of the Royal Society, makes known through his first paper in the *Phil. Trans.* the details of the important line of investigation which finally led to the discovery of the principle of electric conduction and its insulation, as well as to the fact, not the principle, of induction (see Æpinus, A. D. 1759). *Thus, to Grey is due the credit of having laid the foundation of electricity as a science.*

He shows that electricity can be excited by the friction of feathers, hair, silk, paper, linen, etc., all of which attract light bodies even at a distance of eight or ten inches. He next discovers that electricity can be communicated from excited bodies to bodies incapable of excitation. When first suspending a hempen line with pack threads he could not transmit electricity, but when suspending the line with silken threads he transmitted the electrical influence at distances of several hundred feet. The latter he did at the suggestion of his friend Granville Wheeler—Wheler—(not Checler, as Aglave et Boulard have it in *Lumiere Electrique*, p. 20), thinking that "silk might do better than pack thread on account of its smallness, as less of the virtue would probably pass off by it than by the thickness of the hempen line which had been previously used." They afterward tried experiments with longer lines of pack thread, but failed, as they likewise did after substituting thin brass wire for the thread. This showed them the insulating property of silk and led to the discovery of other insulating substances, like hair, resin, etc. During the months of June, 1729, and August, 1730, Grey and Wheeler succeeded in transmitting electricity through pack thread supported by silken cords a distance of 765 feet, and through wire at a distance of 800-886 feet.

Grey demonstrated also that electric attraction is not proportioned to the quantity of matter in bodies, but to the extent of their surface. He likewise discovered the conducting powers of fluids and of the human body. Of the cracklings and flashes of light he remarks: "And although these effects are at present but *in minimis*, it is probable, in time, there may be found out a way to collect a greater quantity of the electric fire, and consequently to increase the force of that power, which by several of those experiments, if we are permitted to compare great things with small, seems to be of the same nature with that of thunder and lightning." (*Phil. Trans.*, abridged, vol. viii., p. 401.)

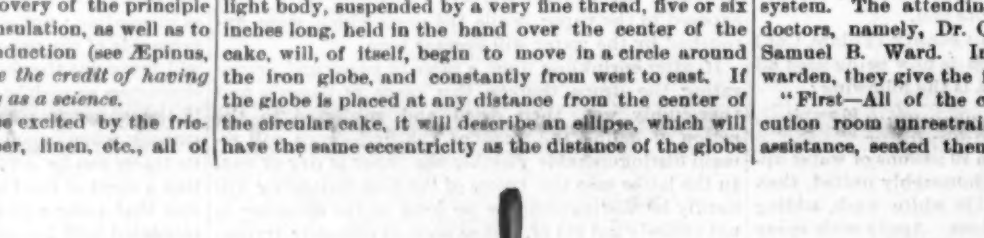
Stephen Grey may be said to have continued his experiments while lying upon his death bed, for, unable to write, he dictated to the last, as best he could, the progress he had made in his studies to Dr. Mortimer, the secretary of the Royal Society. (*Phil. Trans.*, 1733-1736, vol. xxxix., page 400.)

Grey's own description of a new electric planetarium



SWITCH ON THE EDISON DYNAMO OR MOTOR.

deserves reproduction here: "I have lately made several new experiments upon the projectile and pendulous motions of small bodies by electricity; by which small bodies may be made to move about larger ones, either in circles or ellipses, and those either concentric or eccentric to the center of the large body about which they move, so as to make many revolutions about them. And this motion will constantly be the same way that the planets move around the sun, viz., from the right hand to the left, or from west to east. But these little planets, if I may so call them, move much faster in their apogeon than in the perigeon part of their orbits, which is directly contrary to the motion of the planets around the sun." To this should be added the following description of the manner in which these experiments can be made: "Place a small iron globe, of an inch or an inch and a half in diameter, on the middle of a circular cake of resin, seven or eight inches in diameter, greatly excited; and then a light body, suspended by a very fine thread, five or six inches long, held in the hand over the center of the cake, will, of itself, begin to move in a circle around the iron globe, and constantly from west to east. If the globe is placed at any distance from the center of the circular cake, it will describe an ellipse, which will have the same eccentricity as the distance of the globe from the center of the cake. If the cake of resin be of an elliptical form, and the iron globe be placed in the center of it, the light body will describe an elliptical orbit of the same eccentricity with the form of the cake. If the globe be placed in or near one of the foci of the elliptical cake, the light body will move much swifter in the apogee than in the perigee of its orbit. If the iron globe is fixed on a pedestal an inch from the table, and a glass hoop, or a portion of a hollow glass cylinder, excited, be placed around it, the light body will move as in the circumstance above mentioned, and with the same varieties."—*Electrical World.*



SIDE SECTIONAL ELEVATION OF DYNAMO.

The Folly High Pressure Pipe Coupling.

A patent has recently been granted Mr. Cornelius A. Folly, of No. 699 East 138th Street, this city, for an improved high pressure screw coupling for pipes. It is especially applicable to ammonia ice machines, steam, gas and air joints, or to hydraulic systems, and all devices requiring tight joints under high pressures. The joint is similar to an ordinary screw coupling, except that a groove is cut around the inner periphery of the female screw, into which a ring or collar of lead is run. This is formed upon a mandrel of slightly smaller size than the coupling, so that the lead projects a very little beyond the thread of the joint. A small hole, with a thread cut upon it, is made through the exterior of the coupling into the lead-filled groove. A screw plug stops the hole. If now a pipe is screwed into the coupling, it will expand the leaden packing, causing it tightly to fill the screw threads. In case of any sweating or leakage when under pressure, the leak is at once stopped by turning the screw plug. We have seen a number of the Folly joints subjected to the enormous pressure of 5,000 lb. to the square inch without leaking. This was as far as the gauge used would allow. How much higher pressure the joint will stand has yet to be ascertained. On starting a leak purposely when under great pressure, a turn of the small compressing screw at once stopped the leak. The great value, convenience and utility of this simple appliance in the case of ice machine pipes or other high pressure pipes is obvious.

Executions by Electricity.

The new law of the State of New York, for the execution of criminals by the electrical current, instead of by hanging, was enforced for the second time on the 7th of July, upon the bodies of four murderers. The execution took place at the Sing Sing State prison. The death in each case was instantaneous and painless. There can be no question of the superiority of this mode of inflicting the death penalty over the rope system. The attending surgeons were two eminent doctors, namely, Dr. Carlos F. MacDonald and Dr. Samuel B. Ward. In their official report to the warden, they give the following particulars:

"First—All of the condemned walked into the execution room unrestrained, with firmness and without assistance, seated themselves in turn in the electric chair without the slightest protest or resistance, and quietly submitted to the adjustment of the retaining straps and the electrodes.

"Second—In each case unconsciousness was produced instantaneously by the closure of the circuit, was complete, and persisted without interruption until the heart's action had entirely ceased and death had certainly occurred. In each case death was manifestly painless.

"Third—In compliance with the statute, an autopsy was made in each case, as soon as practicable, by Dr. Ira T. Van Giesen, of New York, in our presence and under our supervision, with the result of revealing the same gross changes in the blood and tissues previously observed in cases of death by the action of strong electric current.

"In concluding, allow us to congratulate you on the completeness, in all their details, of all your preliminary arrangements, on the uniform good order and decorum which prevailed during the trying ordeal, and on the resulting demonstration of the rapidity and painlessness of this method of inflicting the death penalty. The experience of to-day has proved to our satisfaction that this method is superior to any other yet devised."

THE earliest Connecticut patent found on record was granted in October, 1717, to Edward Hinman, of Stratford, for the exclusive right and liberty of making molasses from the stalks of Indian corn, in Fairfield County, for ten years, which grant ended with the words: "Always provided the said Hinman make as good molasses, and make it as cheap, as comes from the West Indies."

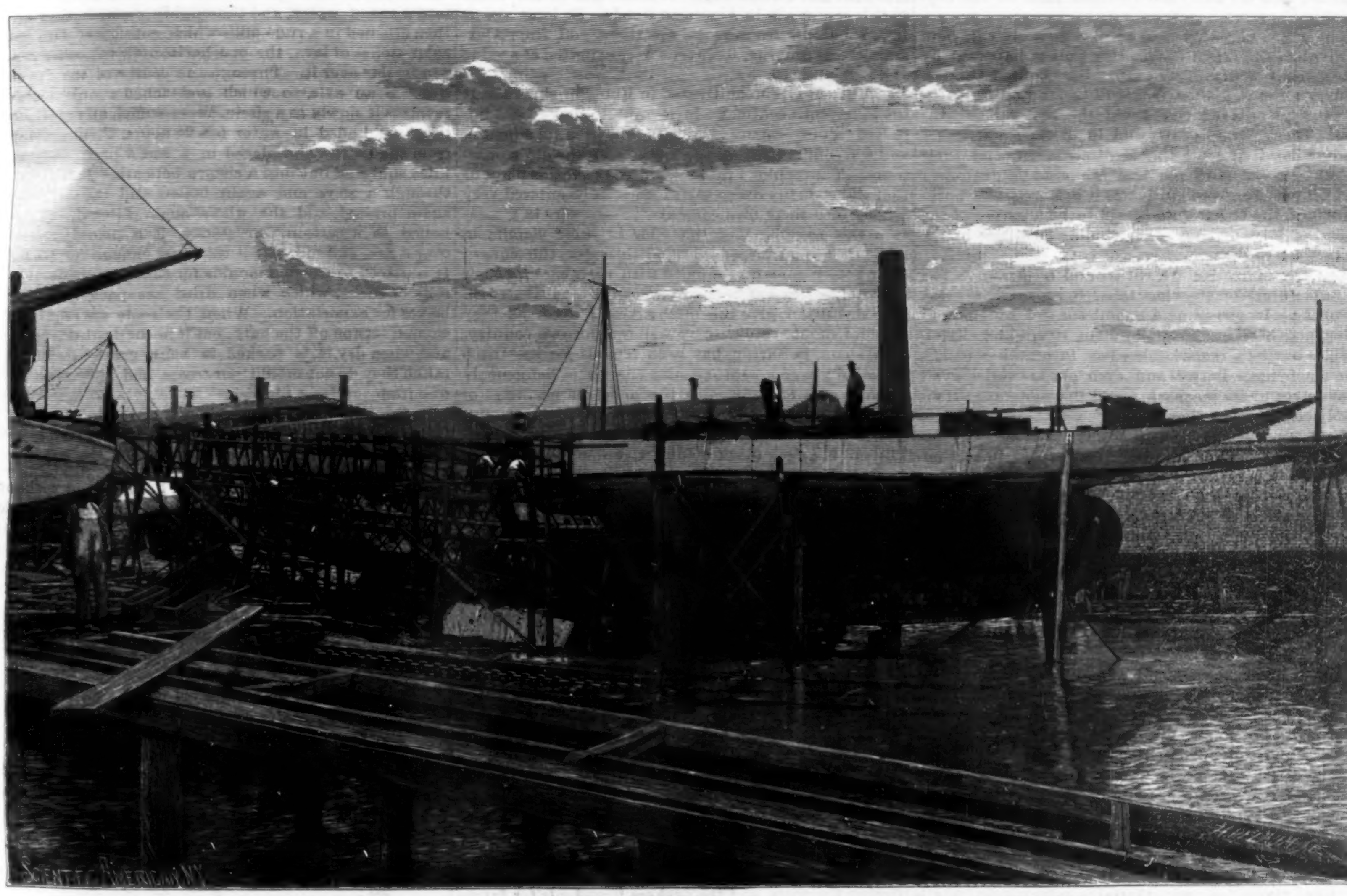
EDWARD BURGESS AND HIS ACHIEVEMENTS.

The name of the yacht Volunteer, which proved the victor in the hard-fought contest for the America's cup in the fall of 1887, will always call up pleasant recollections in the minds of those who take an interest in sailing craft, although just now such memories are tinged with sorrow on account of the recent sudden death of her noted designer, Edward Burgess, which took place in Boston, July 12, of typhoid fever.

The fact that American yachtsmen had been so long successful in holding, against all foreign competitors, a cup first won many years ago in a royal regatta, a prize offered by Queen Victoria, attracted general attention to the race between the Thistle and the Volunteer on that occasion, and the lines and sailing qualities of the two vessels were everywhere discussed. The Volunteer, however, was specially built for this race, her measurements not being decided upon until those of the Thistle were known, and she has since proved to be altogether too large for a sloop rig, as was expected would be the case when she was built. It takes too large a crew to handle such a sloop for cruising purposes, the schooner rig being better for vessels of such size. The Mayflower, which won the preceding race with the English yacht Galatea, was afterward changed to a schooner rig; but in her new rig she is by no means as fast a vessel as she formerly was. General Paine, the owner of the Volunteer, decided, therefore, upon making a radical innovation in changing the vessel to a schooner, and is taking the rather unusual plan of adding to her length by building in amidships an additional section of twenty feet, thereby lengthening her hull to this extent. Our illustration represents the manner in which the work was carried on at a Boston yard, the lines of the vessel forward and aft and her nominal draught remaining unchanged. The Volunteer is steel built, and her original measurements were: 106·23 feet; length on water line, 85·88 feet; breadth of beam, 23·16 feet; depth of hold, 10·90 feet; tons measurement, 209·9. For the photograph from which our engraving is made we are indebted to Mr. N. L. Stebbins, of Boston, Mass.

The designer of the Volunteer, and also of the two previous successful cup defenders in 1885 and 1886, the Puritan and the Mayflower, acquired, through these successive victories, an international reputation, and also introduced a new era in yacht designing. Burgess modified the construction which was formerly the distinguishing characteristic of American yachts—a great breadth of beam and light draught, with center board, which caused them to be generally designated by foreigners as "skimming dishes"—giving his new designs more keel, thus making more seaworthy craft, while their lines and proportions were such, as the event proved, to combine the greatest number of advantages. Instead of blunt ends, inside ballast, no shape, no head room, and small sails, appeared the outside ballast, shapely hull, and large sail spreads which distinguish the fleet in this country to-day. Mr. Burgess set a pace in the development of the American model which he only could hold until within the last two or three years. He made bold strides in the way of utilizing power in the hull to carry canvas, and always maintained that a roomy boat, wide enough to give comfort, able deck room and sails to drive her, is a much better type of yacht than a narrow, deep vessel with a small spread of canvas. Until convinced two years ago that in the smaller classes a keel boat gives greater opportunities for speed, he advocated center-board boats on account of the shallow water in American harbors, but as racing has been narrowing down to a contest of science for a margin of seconds, Mr. Burgess has merely tried to embody in his designs the features shown by the experience of himself and others to produce speed. He did not, however, give his yachts the extreme keel characteristic of English cutters, and perhaps the best evidence of his success is found in the partial adoption by many English yacht builders of the ideas developed in the building of the Burgess yachts. It was especially noted that the Thistle, in the famous races four years ago, had a breadth of beam quite unusual for an English cutter, and it is now matter of comment that it is not always easy to determine an English from an American built yacht, on account of the modifications which have been made in the construction of the yachts of both nations, largely as the result of the work of Edward Burgess.

Mr. Burgess was born in 1848, and graduated from Harvard in 1871, afterward becoming instructor of entomology in the University and secretary of the Boston Society of Natural History. In 1881 he had to give up work on account of his health and took to yachting, which led to his finally becoming a naval architect and yacht broker. He was a member of the United States Naval Board to award prizes for the designs of cruisers and battle ships in 1887, and in 1888 he was appointed permanent chairman on the Board of Life-Saving Appliances in the United States Life-Saving Service. Mr. Burgess was also the designer of the well-known racers Sachem, Titania, Papoose, Baboon, Nymph, Wraith, Sprite, Saracen, Rosalinda, Chiquita, Marguerite, and many others, over a hundred in all, including the steam yachts Shearwater, Sapphire, Unquewa, and Jothniel, and the well-known flying fishermen Carrie E., Phillips, Nellie, Dixon, and Fredonia.



LENGTHENING THE VOLUNTEER, DESIGNED BY THE LATE EDWARD BURGESS.

THE whaleback steamer C. W. Wetmore left Montreal on July 4 with 90,000 bushels of wheat bound to a channel port for orders. The grain inspector's certificate was granted and her cargo stowed according to the line and rule held where whole cargoes are shipped.

Discouragement of Inventors.

Paul and Wyatt, says S. N. D. North, in the *Popular Science Monthly*, taught the world how to spin a hundred or more threads at one operation; but years elapsed after these early inventions before they came into general use. Paul worked his own machines for many years; but when he died they were broken up and sold, and the world continued to spin on the foot wheel. The tardy realization of the value of these inventions was due primarily to the opposition of the hand operatives to the introduction of anything in the nature of improved machinery. The guilds were strong, and determined in their refusal to operate or tolerate new devices for dispensing with hand labor. Poor John Kay, after inventing his fly shuttle, was compelled to close his mill at Leeds by the riotous hostility of the hand weavers. Learning that he was also engaged in devising machinery for spinning, a mob broke into his house, destroyed everything it contained, and would have killed the inventor himself had not friends smuggled him away in a wool sheet. We need not be surprised at the blind brutality of these ignorant workingmen. They looked upon the inventor as an enemy, planning to take the bread from their mouths. But what shall we say of the manufacturers who stole the patents of Kay, without recognition of the service his genius had done them? And what shall we say of the government which permitted this man, in his old age, without recompense for inventions which added untold millions to the wealth of his country, to seek refuge from persecution in France, there to die in abject penury?

Influence of Drugs on the Heart.

The temporary expansion and contraction of the heart under the influence of certain drugs formed the subject of a paper read by Professor Germain Sée at the last meeting of the Academy of Medicine, Paris. The professor, in collaboration with Dr. Pignol, gave the following summary: (1) Sparteine is the substance which diminishes most promptly and effectually the volume of the heart. This drug strengthens the cardiac muscles and augments their vital force. (2) Digitalin also contracts the heart, but only when its cavities are already in a state of dilation. (3) Iodide of potassium tends to contract, but to a less degree than sparteine. (4) Antipyrin expands the volume, but without influencing arterial pressure. (5) The action of bromide of potassium may be taken as the opposite of iodide of potassium, but as similar to antipyrin. It dilates the whole organ, the right side being slightly more affected than the left. Certain other drugs have no effective action. Caffeine, says Prof. Sée, has no influence on the cardiac muscles, in spite of certain assertions to the contrary.

Licorice.

BY NICOLAS PIKE.

The order of plants Leguminosæ contains very many of our best known and most useful ones, and in it the wild weed that gives the licorice of commerce. It belongs to the genus Glycyrrhiza, though many other plants of near genera have roots that possess similar qualities. Especially is this the case with the *Abrus precatorius* Lin., that grows abundantly in the West Indies, notably in Jamaica, and in the islands of the Indian Ocean. It ranks over old hedges and fences with a strong, twisted, rugged stem; bears an insignificant little flower, that gives a rough pod inclosing the little scarlet seeds tipped with black so well known. When not fully ripe they are pierced and strung together to form necklaces, bracelets, rosaries, etc., frequently mixed with the larger silvery seeds of "Job's tears" (*Coix lachryma*). I have seen many of the colored nuns, or *Sœurs de charité*, counting their beads while patiently watching the couch of sick and dying sailors. The long rosaries were made of the red and white berries and the prayers marked off with sandalwood beads. The roots of the *Abrus* are used by all Creoles for chewing and other purposes in various bronchial ailments. They have the taste of licorice, but do not yield the rich juice of the Glycyrrhiza.

There are three species of plants, both wild and cultivated, that yield the licorice that is imported by many tons every year into the United States. They are the *G. glabra*, *G. glandulifera* and *G. echinata*, the latter being considered the best for cultivation. These plants grow wild in all the countries of Europe bordering on the Mediterranean, and their habitat extends through Asia Minor to Central Asia and China. England cultivates it in Surrey and Yorkshire, and the *G. lepidata* is said to be a native of the plains of Missouri and other similar localities in the Southwestern States.

The uses of licorice are varied and numerous. The manufacturers of chewing tobacco consume a great quantity. It serves as a demulcent for coughs and colds, and is an ingredient in many sirups and elixirs, besides having a remarkable effect in masking nauseous medicines. Porter and even ale breweries avail themselves of its saccharine, and the roots are extensively employed by them.

It is imported in different forms; in the roots, also in rolls or sticks of the dried inspissated juice that come packed in sweet bay leaves. The licorice imported into England from Calabria, Sicily, goes by the name of Solazzi or Corigliano juice; that grown in Yorkshire is made into a confection called Pontefract cakes. The roots of the licorice contain a large amount of sweet, mucilaginous juice, that owes its sweetness to a peculiar principle called *glycion* or *glycyrrhizin*, which is present in both roots and leaves. The sugar is said to be not crystallizable, and not susceptible of vinous fermentation.

The cultivation of this plant would have been arduous in former years when there was only hand labor, and money scarce. There is now plenty of the latter article lying idle; agriculture has also made such rapid strides, and the introduction of the wonderful labor saving machines now in use for plowing, etc., would render the successful growth of the plant almost a certainty. It could then be put on the market pure, for even licorice has not escaped in this age of adulteration, as starch, rice and wheat flour, and even wood ashes have been used for this purpose. I have carefully collected every available information on the subject, and its growth and cultivation in Europe. I give it for the benefit of those willing and able to introduce fresh objects of commerce to utilize lands good for no other purpose, and to give profitable employment in the gathering season to numbers of willing but often idle hands.

I will first speak of the licorice a native of Southern Europe. The qualities in different countries vary greatly. It is said that the juice from Turkey and Greece is bitter, of Sicily and Spain sweet and rich, but that of Italy the richest, though less is exported thence. I am not aware of licorice being cultivated in any of these countries, as it is so vigorous and abundant a wild plant, almost too much so in many places. In Spain it grows finest in the rich bottom lands of the great rivers, and the crop depends much on the mildness or severity of the winters. It is of such vigorous growth that other weeds cannot encroach on it and crowd it out, and no parasite or insect pest is known to infest it. It is so tenacious of life that if only a small portion of the root is left in the ground after the collecting season, it shoots up again. There are two kinds of licorice, one sending down a tap root from 3 to 6 feet deep and the other runs underground from 6 inches to 2 or 3 feet. The latter is the most highly prized, from the facility with which it is dug up. Only the roots are used, the tops being burned for fuel. It varies in quantity and quality according to soil in different provinces, changes its color to red, yellow or brown, and the proportions of saccharine and starch vary also. The climate best suited to the growth of licorice is that where oranges and all the citrus family thrive, as it cannot endure severe ground frosts nor cold high altitudes.

In Sicily it grows most luxuriantly in low lands adjacent to streams of water. The valley of the river Simeto is so rich that, with the rudest tools and culture, the peasants have no difficulty in growing cereals and other plants for food. Their principal trouble is keeping down the weeds that spring up so abundantly in the cultivated lands, and the licorice from its pertinacity is most dreaded. A farmer when asked if it grew on his farm replied, "God forbid! for of all wild vegetation, it is most difficult to subdue." A crop can be gathered every three or four years from the same ground, and the digging commences after the autumn rains have set in. Licorice requires the hot sun to perfect its juice, but at the same time it bakes the ground so hard, the task of collecting the deep-set roots would be too laborious and expensive till the earth is well saturated. There are seven manufactories in Catania alone, and they produce from 700,000 to 800,000 lb. annually, and others in various cities of the island. Very little of the root is exported either from Sicily or Italy, only the rolls or sticks made from the inspissated juice. Asia Minor exports largely to the United States, mostly in sailing vessels under the Austrian and Italian flags. A great deal of the trade in this country is in American hands. So long ago as 1885, steam presses were in use there, and from Alexandreth, in Smyrna, 6,000 tons were exported at a value of about $192,000.

Licorice has been cultivated in England since about the fourteenth century. It is said to have been imported from Germany (a fact I doubt from its climate), and was cultivated in the gardens of the old monasteries. The monks, I presume, introduced this plant as they did so many other useful ones, as it entered very largely into their medicaments. They were in a measure the guardians of the poor in their vicinity in those days, and dispensed medicines for the cure of their bodily ailments, equally with their care for their souls. Licorice has been so successfully cultivated in England that I give the methods employed, as they would, I should think, serve well for our own country.

Mitcham, in Surrey, has been famous for its "herb farms" for over a century, and the air is redolent in summer and autumn with the delicious perfumes of lavender, thyme, rosemary, chamomile, peppermint, and other plants used in medicines or for distillation. The soil is a deep black mould, with some admixture of sand, and considerable licorice has been grown here. The plant is graceful, with feathery pinnate foliage, grows about two to three feet high, and bears small whitish yellow flowers. Since licorice has been imported into England duty free, the crops have been less attended to, as other plants pay better.

Near Pontefract, Yorkshire, it has been long successfully cultivated. The soil is a sandy loam, and has to be of considerable depth to allow the roots to develop well. The beds are prepared by being well trenched, the width of trench and bed averaging three feet, and having the appearance, when finished, of wide celery beds. Commencing early in April or late in March, a top dressing of stable manure is applied and lightly covered over, leaving the trench about six inches below the raised bed. Holes are made with a small spud a few inches apart, and another person follows (often a girl) with a basket of buds and suckers, slips or runners, and they are inserted about four inches below the surface and covered to that depth. This forms a double crop, that is, the buds grow downward, producing the roots, and the suckers form buds for future planting, the width of the beds permitting of cross rows of plants. The buds and suckers are left in the ground for three and a half years, a crop being obtained in the September following the fourth spring. The first manuring is sufficient, the plants being weeded each summer. A hot, dry season is best for them; they need no irrigation even in the hottest weather, and are free from all insect pests.

The trenches are of course idle for two years, as the plant tops do not show much in that time, so potatoes are planted in them the first year. A species called ash potatoes is used, as they have such small tops they do not overshadow the young licorice plants as larger kinds would.

The second year a crop of cabbages is grown, but the third year the trenches must lie fallow, as the licorice then shows luxuriant growth, and presents in the summer the appearance of a shrubbery of young ash trees. The grower plants a fresh crop every spring of each year, and in autumn harvests the one of three and one half years' growth.

The only labor required is that the beds be kept clear of weeds in summer, and in November, when the sap is down, the plant tops must be cut off. If the winter proves unusually severe, the tops can be covered with a light layer of earth.

TO GATHER AND PREPARE THE ROOT.

The trench, not the bed, must be dug down to a considerable depth, thus exposing without injuring the roots, and the whole plant is very carefully taken out of the ground. The earth from the second trench is then thrown into the first, and so on to the end of the field. The roots are then placed in dry cellars after removing the tops and suckers and often covered with sand. The latter serve for the next spring's crop to produce "buds," that is roots in their early stage for another year. When the stored roots are dry, they form the yellow licorice for producing the juice of commerce. A small portion of the top of the root is cut off as being of less value than the rest, and is ground into powder and sold to chemists for various uses. The tops are only good for burning.

The 3½ years' sucker, which is gathered with the licorice plant, has now produced "buds," which are reserved with the new suckers for planting. They are either stored in a cellar and covered with rotten dung, or they are made into a mound, outside, and well buried in earth or moist sand, and thus withstand the cold, wet winters of Yorkshire.

There appears to be considerable difficulty in finding out some of the first processes of the manufacture of licorice. Mr. Hilliard, who has the largest factory in Pontefract, courteously shows the place to visitors, with the above reservation.

In Sicily, when the roots are dug up, they are bound in bundles and stored in the factories for some time to season them. When sufficiently cured, men and women cut them into short pieces, and then they are plunged into a vat of water, and thoroughly washed; they are then crushed in a rude mill, which consists of two circular stones of lava, the one horizontal, the other perpendicular over it. Through the center of the upper stone is an axle, to which is attached a mule, which revolves it slowly in a circle. When sufficiently crushed, they are boiled in water for 24 hours, then removed from the kettles and placed in a screw press, and the juice squeezed out into a cistern beneath. It is passed through a sieve and again boiled, and the sediment again pressed, and the whole again filtered. When boiled to a certain consistency, it is placed in pans over a fire, and men stir it till dense enough for paste. It is placed in wooden moulds for cakes, or made into rolls or sticks, which when dried are packed in bay leaves for exportation. When the roots are required, women scrape off the bark, cut it in the desired length, and when dry it is packed in bags, great care being taken they do not mould nor freeze, and they must be free from the least blemish.

In England now the greater part of the juice manufactured is from roots grown in Spain and Sicily, as the English ones are of smaller size. As the passage is so rapid now over the ocean, a package of roots, buds or suckers could be brought as fresh and easily, perhaps more so than from one of our own Western States, and doubtless from the greater heat here they would improve in size. It would not be difficult to procure fresh wild roots and buds direct from Spain. There is direct intercourse with Seville, whence licorice is shipped to England by steamers or by sailing vessels direct to America. An ordinary Wardian case could be sent to Seville and would bring back roots and buds enough to start a licorice farm.

Allowing for the difference of climate in England and the United States, anywhere south of Washington, D. C., ought to produce licorice of fine quality with careful culture. There are plenty of low-lying lands good for nothing else that could be permanently profitable for it, where ground frosts are light. I say ground frosts, because there is no leafage in winter to be injured. The average latitude where licorice flourishes near the Mediterranean is from 36° to 41° N. lat., in Mitcham, Surrey, 57° 30', and in Pontefract, 53°.

Chinese Varnish.

The British consul at Hankow, writing of the varnish exported from that city, says he is informed that it is the gum of a tree—the *Rhus vernicifera*. On this tree, before daylight, incisions are made; the gum that runs out is collected in the dark, and strained through a cotton cloth bag, leaving behind a large amount of dirt and refuse. This operation can only be performed in the dark, as light spoils the gum and causes it to cake with all the dirt in it. It cannot be strained in wet weather, as moisture causes it to solidify. When the Chinese use this varnish, they rub it on with a sort of mop, or swab, made of soft waste silk. It should only be used in wet weather, as, if the atmosphere is dry when it is rubbed on, it will always be sticky. As used by the Chinese, the varnish takes about a month to dry, and during the time it is drying it is poisonous to the eyes. The consul thinks that this gum may have been one of the ingredients of the celebrated Cremona varnish, and he suggests that it might be worth the while of musical instrument makers to make experiments with it, with a view to producing a varnish that would give a mellow instead of a glassy sound.

Progress of the Manchester Ship Canal.

A short section of the Manchester Canal has been so far completed as to permit the entrance of tide water. This section extends from the river Mersey, at Eastham, to Ellesmere Port. The opening took place June 23 last.

LOCUST VISITATIONS.

During the past three or four years the French government has been making strenuous exertions to beat down the armies of locusts coming from the south on to the fertile lands of Algeria, and during the present year they are also having a similar fight with these pests on the southern borders of Tunis. The cheap Arab labor obtainable for this purpose has made it possible to employ in the work a veritable army of men, the government ordering the tribes to form encampments along the line on which it is proposed to fight the oncoming army of locusts, and, in this way, the crops have been in a great measure protected from the ravages of this plague, although no permanent relief has been obtained. Our illustration, from *Le Monde Illustré*, Paris, gives a good idea of these destructive insects and also of their carnivorous instincts, always exercised upon the weak when there are no crops to feed upon, as well as the manner in which their eggs are deposited in pockets in the earth, the covering having been removed from the exposed bunches of larvæ.

The manner of fighting the locusts adopted in Algiers and Tunis has been to construct a ditch, or a ditch with a fence at one side, across the line of march of the insects, which come in such vast numbers that the ditch quickly becomes filled up, when the natives jump in and trample them to death at the same time thrashing the living mass with a heavy stick or log of wood. The fence at the side of the trench consists of long bands of cotton cloth or calico supported on sticks, such fences extending in some places across a mile or more of country, the material at the top having a slippery waxed border about four inches wide, kept moist by daily oiling. The insects cannot keep their hold on this waxed border, and inevitably drop back into the trench beneath, which is from three to four feet deep. When the insects have attained an age where all or a portion of them have wings, they are fought by a line of natives with long palm switches, a method of stopping their progress which, to be effectual, presupposes the simultaneous exertions of grert numbers of the Arab palm wielders.

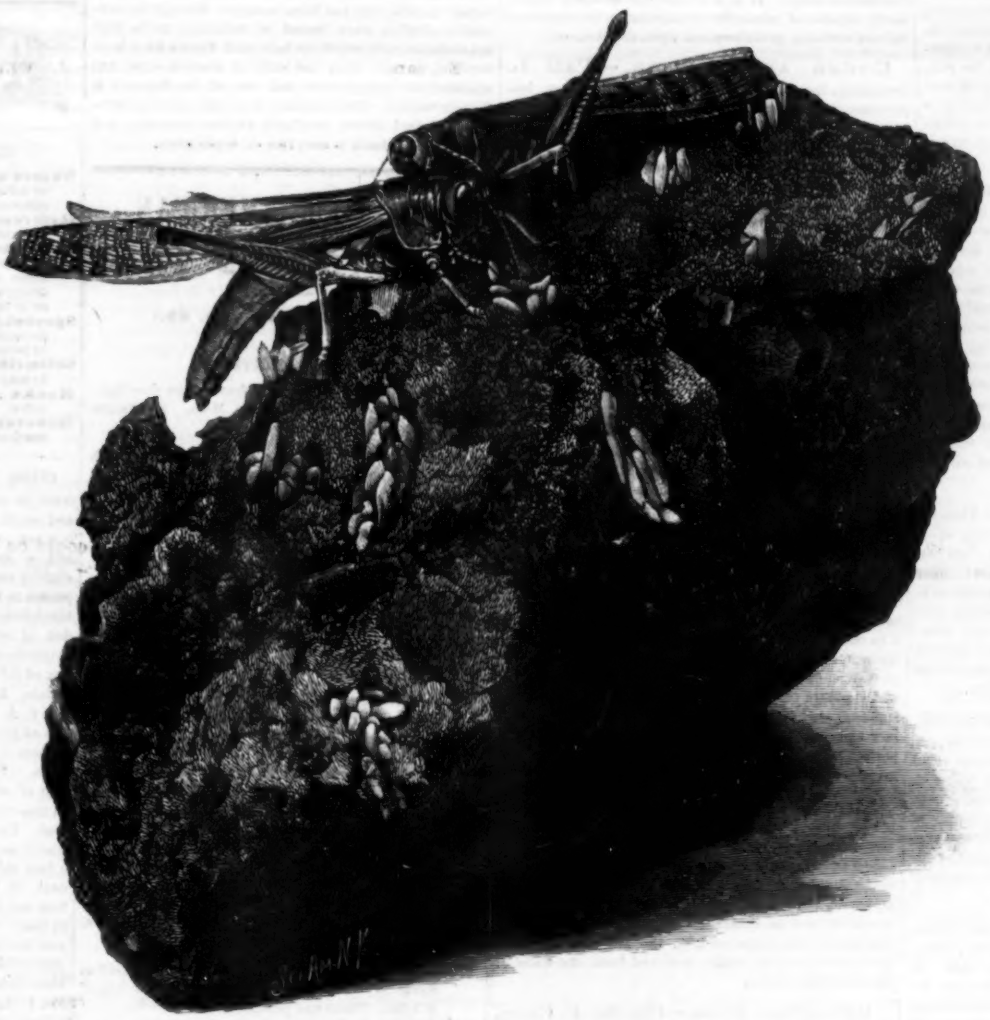
Prof. C. V. Riley, the entomologist of the Department of Agriculture, at Washington, has made a most thorough study of the locust as it occurs in several different varieties in the United States, with the best means of destroying them, and his widely published researches on the subject have undoubtedly been of great advantage to our farmers.

The locust, as is generally known, is of the family of grasshoppers and crickets, but differs from them in having shorter horns and feelers and a more robust body and limbs. The Rocky Mountain locust, which has been the most destructive pest that has appeared in this country, breeds every year in a large section, embracing most of Montana and Wyoming, western Dakota, and a part of Colorado, Utah, Idaho and Oregon, together with a large region in the British possessions. In a country directly to the east of this section is a considerable region where the locust is liable to breed for some years, multiplying in excessive numbers, but from which it in time disappears. Through a very much larger section, extending almost to the Mississippi and the Gulf on the east and south, and to the Pacific on the west, the locusts migrate in years of excessive abundance, and it is in such migrations that they are most destructive, although in these regions they seldom breed, and generally disappear within a year. The most disastrous invasion of this kind was in 1874, when Colorado, Nebraska and Kansas were overrun, and parts of Wyoming, Dakota, Minnesota, Iowa, Missouri, New Mexico and Texas were ravaged, vast swarms of locusts from Montana and British America sweeping over these sections in that year. In 1875–76–77, considerable damage was done by the locusts, but the boundaries of its depredations were narrowed each year, and they have not since visited any considerable area beyond the limits of their known permanent habitat.

Although the eggs of the locust may be laid in almost any kind of soil, they are by preference laid in bare sandy places, especially on high, dry ground, which is tolerably compact and not loose. The female forces a hole about an inch below the surface by means of two pairs of horny valves which open and shut at the tip of her abdomen, until, usually in a few minutes, nearly the whole abdomen is buried, when she commences ovipositing, there exuding from the tip of the body a frothy, mucous matter, which fills up the bottom of the hole, the mucous matter also being exuded to bind all the eggs in a mass, and when the last is laid, to fill up the neck of the burrow with a compact and cellulose mass, more or less impervious to water. When the locusts are abundant, they settle so thickly in favorable spots for depositing their eggs that the ground has been frequently seen darkened with them, the eggs deposited by a well developed specimen ranging from 100 to 150 each, while the holes are generally so well covered as to afford no evidence of the deposit.

The insects are hatched from the middle of March to the 1st of June, and when they are about half grown, and vigorous enough to bare the ground of vegetation, the habit of migrating in large bodies is developed, those which acquire wings traveling long distances, according to the wind, while those which do not seldom go more than a few miles from where they hatch. The remedies and devices proposed, and to some extent adopted, for the destruction of locusts have been very numerous. The protection and encouragement of birds, particularly by the paying of a reward for hawks, as is done in Colorado, is a natural agency not to be overlooked, but the destruction of the eggs has long been looked upon as the most efficient means of averting locust injury. This is effected by harrowing, plowing or spading, irrigation, tramping, or collecting. In 1874 and 1876 there were many locations where for hundreds of square miles it is said that scarcely an inch of the soil could be stirred without exposing these eggs, so that, although the task of getting rid of them would vary with the location and the means at hand, it was manifestly one of great magnitude. For the performance of this work in various ways a great number of novel machines have been introduced and numerous patents therefor have been issued, as also for the destruction of the young or unfledged and the mature or winged insects.

Some of these machines consist of a scraper with converging wings and with a removable canvas bag at the rear end. As the machine is moved over the ground by horses or other power, the locusts are scraped together and collected in the canvas bag, which may be readily removed and another put in its place. There is very little delay or loss of time by this method, and it is possible to clear large tracts of land without great effort. It would appear that this method is much cheaper and more certain and efficient than the oriental methods employed in the destruction of these pests in the northern coast of Africa.



LOCUSTS AND LARVÆ ON A CLOD OF EARTH—FROM A PHOTOGRAPH.

Central American Timber.

Colonel E. H. Morrison, who has recently returned from Nicaragua, in an interview, in a Seattle paper, called attention to the fact that when the construction of the big canal got fairly under way, a large amount of lumber would be wanted from the Puget Sound mills. He pointed out that there was no lumber in Central America suitable for the purpose. The hard woods indigenous to that country are not found in such quantities as to be cheaply logged.

A mistaken impression is abroad in regard to the forests of that section. People have a general idea that great tracts of country are covered with splendid trees, so that one can go into the forests anywhere and cut good logs suitable for lumber. The fact is that, though the forests are thick, the majority of the trees are too small to be worth cutting. Here and there a large mahogany tree is found, and a man chops it down. In order to get it out he has to cut a trail through a quantity of worthless timber and run it down the nearest river. There will probably not be another tree worth cutting for a long distance. It is by the slow collection of logs cut from isolated trees in this way that the shipments are made. The cost of logging and of holding a stock of logs until there is enough to ship make these kinds of lumber so expensive.

"Many people have been fooled by the expectation of immense fortunes in lumbering in Central and South America. A friend of mine took a complete sawmill and logging outfit, with a party of skilled men, to one of the South American rivers, expecting to do wonders. He found the ground swampy, swarming with reptiles, and covered with such a dense jungle that traveling through the Puget Sound woods is a picnic by comparison. He also found that there was only a tree here and there worth cutting, and by the time he had cut a trail to it, the beginning of his trail was so thickly grown up with brush again that he could hardly find it. After one night's rain the brush would grow up to a height of six feet in a day. He was glad to get out of it again.

"There is one tree down there called the snakewood, which grows to a great thickness, but when you come to chop it down, you find that it is nearly all soft bark. When you do finally come to hard wood, it is extremely hard, but there will be only about four inches of it in a tree as many feet in diameter. It is used mainly for canes, which cost $3 or $4 in South America and several times as much in this country.

"There are a number of good kinds of lumber down there which would be useful, but have never been brought into use. I suppose they happen never to have become fashionable. Yet they are of fine shades and beautiful, fine grain, and would look well in furniture and interior decoration. They grow thicker than the better known hard woods, and would be much cheaper."

Frequency of Thunder Storms.

A German periodical gives statistics concerning the frequency of thunder storms in various regions of the world. Java has thunder storms on the average 97 days in the year; Sumatra, 86; Hindostan, 56; Borneo, 54; the Gold Coast, 52; Rio de Janeiro, 51; Italy, 38; West Indies, 36; South Guinea, 32; Buenos Ayres, Canada, and Austria, 23; Baden, Wurtemberg, and Hungary, 22; Silesia, Bavaria, and Belgium, 21; Holland, 18; Saxony and Brandenburg, 17; France, Austria, and South Russia, 16; Spain and Portugal, 15; Sweden and Finland, 8; England and the high Swiss mountains, 7; Norway, 4; Cairo, 3. In East Turkestan, as well as in the extreme north, there are almost no thunder storms. The northern limits of the thunder storms are Cape Ogle, northern part of North America, Iceland, Novaja, Semelja and the coast of the Siberian ice sea.

RECENTLY PATENTED INVENTIONS.

Engineering.

OIL BURNING FURNACE. — Frank B. Meyers, Fort Plain, N. Y. This is a simple and durable hydrocarbon burner, designed to completely atomize the oil and permit of directing the flame from the center to one side, to distribute the heat uniformly within the furnace. A pipe is held centrally in a casing connected with an air supply, an oil pipe discharging into the central pipe, on the inner end of which is held an atomizing disk, while a valve formed of two plates having semicircular openings at their inner edges is fitted to slide transversely to regulate the admission of air to the casing without shutting off the air supply to the central pipe.

Mechanical Appliances.

BOLT GRIP. — Thomas Spriggs, Little River, Kansas. A pair of spring-pressed jaws pivoted in a frame have converging points with inwardly extending thumb screws in their upper ends, a wedge-shaped chisel sliding in the frame between the thumb screws, a yoke being fixed to the chisel and extending beyond the frame, while a screw mounted in the yoke and frame has a suitable handle. The device is designed to be very useful in removing carriage bolts and tire bolts from wheels, or where a nut has become rusted upon a bolt, and it also may be used instead of pinchers for pulling nails, etc., and for clipping bolts and rivets and holding gas pipe.

PUMP.—Charles J. McKenzie and David M. Mikesell, Wauseon, Ohio. This is a double-acting force and lift pump of simple and durable construction, not liable to get out of order. The pump has a cylindrical barrel with no projections whatever on its outside, permitting of its being placed in a fixed pipe such as are usually employed in drill wells, and it pumps a continuous stream of water on the up and down stroke of the plunger, the water being lifted or forced to any desired height.

COOLER FOR CALCINED MATERIAL.—Amable B. Bonneville, Allentown, Pa. This is a cooling apparatus more especially designed for use in manufacturing Portland cement, where the stone is subjected to a high heat to combine the lime, silicate, and alumina, excluding air as much as possible while the material is highly heated. The material after burning is discharged by a conveyer into a receptacle in the shape of clinkers, the receptacle having at its inside a series of hoppers forming air spaces connected by openings in the wall with the outside, whereby the calcined substances are cooled without undue exposure to the atmosphere. It is designed to take about three days to draw the material from the top to the bottom, thereby insuring a slow and gradual curing and cooling of the clinkers.

ASBESTOS SEPARATOR. — Henry Powers, Cranbourne, Canada. Rock containing short fiber, usually considered worthless, may, by this improved apparatus, be manipulated in a simple manner to extract the fiber contained as a clean and marketable article. The method consists in simultaneously pulverizing the rock and crushing the asbestos in it, causing the disintegration of the asbestos in an agitated body of water having an upward current to float off the fibers, the pulverized rock sinking in the water.

ORE WASHER. — James O. Campbell, Colton, Utah. This device is designed more especially for washing gold sand, to obtain all the precious metal it contains without a great expenditure of water or labor. It is designed to be simple and durable in construction and very effective in operation, consisting of an inclined frame mounted to slide laterally and supporting a series of buckets arranged one in front of the other and one above the other, the higher one discharging into the next lower one.

CLEARING AND EVAPORATING SACCHARINE JUICES.—Ramon F. Cordero, Rubio, Venezuela. There are cleaning pans directly over the furnace of this apparatus, and on the furnace flue rests an evaporating pan having a longitudinal partition forming a return channel, one of the cleaning receptacles discharging into this passage at its end over the furnace outlet. The apparatus has other novel features, and is designed to be economical in fuel, for which only cane refuse is used, while presenting extensive evaporating surface, the juices being successively cleaned in the several pans and the scum removed before passing to the evaporating pan.

ELECTRIC APPARATUS FOR DEFECATING SACCHARINE JUICES. — Elias Maigrot and Jose Sabates, Havana, Cuba. Combined with troughs having longitudinal porous partitions, with pipes connecting the two sets of compartments in two separate series, one series for the circulation of water and the other for the circulation of saccharine juices, are electrodes suspended in the compartments and connected with an electric generator. The apparatus is designed to give an increased yield of prismatic sugar by subjecting the juices to the action of electric currents, to decompose, alter, transfer and remove from the juices alkaline salts, acids, albuminous and other deleterious substances.

Agricultural.

CULTIVATOR. — Edward W. Freiburghouse, Sabetha, Kansas. In this implement a number of disk cutters are employed, held in adjustable hangers, forming a cultivator capable of effective work on level ground, on a hillside, or for cultivating side ridges, as in listed corn. The cultivator blades are designed to be conveniently and expeditiously adjusted laterally to throw the dirt away from or toward the plants and adjusted vertically to stand at any desired angle to the ground.

Miscellaneous.

SPRINKLER. — Alpheus J. Bartlett, Pomona, Cal. Combined with a tubular body having a branch and a packing located at the top of the body is a T-shaped sprinkling tube, whose vertical member extends through the packing into the body, and has an exterior collar of less diameter than the body, adapted to turn upon a water cushion or bearing. The device forms an improved rotary lawn sprinkler, whose rotary section revolves upon a water bearing, thus reducing the friction to a minimum.

VEHICLE STEP. — Milton Frost, New Bedford, Mass. This step consists of a wheel mounted to turn on a sleeve secured to the shank supporting the step, the wheel having an open web, and a scraper in the form of a rubber ring being arranged concentric with the rim of the wheel and held in the open web. The construction is simple and durable, and insures safety by preventing the foot from slipping off the step.

TOY MORTAR.— Edward P. Eastwick, Jr., New York City. This mortar has an annular rounding shoulder or swell within its bore in rear of the muzzle, forming a cup-shaped or flaring seat for the ball, while a firecracker opening leads through the upper side of the barrel at the breech, it being designed to fire a ball by the explosion of the ordinary firecracker, without incurring the danger common to toy fire arms charged with cartridges.

CHIROPODIST'S FILE. — Charles S. Levy, New York City. The body plate of this file is essentially triangular in cross section, while it has an upper semicircular file surface and a lower flat file surface, a recessed core being secured within the body, which consists of a strip of metal bent upon itself to the desired shape. It is a simple and compact implement, capable of convenient manipulation for removing callous surfaces, protuberances upon the skin, etc.

COOLER AND FREEZER. — Paul L. Dermigny, New York City. This invention is an improvement on a former patented invention of the same inventor, and provides a simple and durable apparatus, especially intended for family use, to cool or freeze water and other liquids, or to make ice cream, etc. It has an outer and an inner receptacle, with a chamber between them for the reception of the water or other liquid to be cooled or frozen, while the freezing mixture is contained in the inner receptacle, which has two sets of beaters or stirrers that are revolved in opposite directions by the turning of a crank arm.

FILTERING APPARATUS.—William E. Hershberger, Neosho, Mo. Combined with a vessel having a series of apertures in its bottom, is used a filtering block of porous material, preferably tripoli stone, in cylindrical form, the block having a recess in its lower face forming a flange resting on the bottom beyond its openings, while a series of passages lead up into the block from the recess. The block is fastened in place by a bolt, so it can be readily removed for cleaning, and has a sufficient number of passages to adapt it for filtering a large quantity of water for drinking or other purposes.

LIFTING JACK. — Joseph S. Locke, Bartonia, Ind. This invention is more particularly designed for wagon or carriage jacks, when the lifting bar is of stepped construction on its upper end, to adapt it to varied heights of the axles from the ground. The invention covers a novel construction of parts and pivoted connection of two levers with the lifting bar and standard of the jack, whereby the lifting bar and standard are hinged together, and kept from shackling, increasing the durability of the jack, while a more perfect lock is secured, the lock being the tighter as greater weight is thrown on the jack.

STOVE. — William Forbes, Plainwell, Mich. This invention relates to heating stoves in which either coal, coke, or wood are used as fuel, the construction providing a large area of heating surface that has direct contact with the burning fuel and the air surrounding the stove. The fire pot of this stove is revoluble, and is composed of hollow bars or tubes that have communication with the air outside of the stove, and it can be readily removed from the walls of the stove for repairs.

REVOLVING DOOR.—Charles F. Chew, Philadelphia, Pa. Combined with two oppositely curved casement walls, a rounded cap plate and a circular floor, is a main door pivoted at its center in the cap plate and floor, curved wing walls being hinged and braced to the door, forming an improved revolving storm door. The device permits the free ingress and egress of one or more persons at a time, and seals the outer opening simultaneously with the opening of the inner one, thus affording a vestibule for the protection of an exposed entrance to a building, while providing a wide and unobstructed passage.

HANDLE. — George H. Bradshaw, Knoxville, Tenn. This invention provides a simple and convenient handle designed to be readily attached to or removed from chests, trunks, refrigerators, etc., and which when not in use will drop out of the way, so as not to be easily broken. The device consists of a plate to be secured to the article, and having projecting shoulders near a side and bottom edge, and a handle pivoted on the plate to swing laterally between the shoulders.

FOLDING POULTRY CRATE.—Harry B. Cornish, Hampton, Iowa. This is designed to be a very simple and durable crate, which can be expeditiously set up to receive poultry, and readily folded for return transportation. It has an apertured and ribbed top plate and a solid flanged bottom plate, apertured side pieces hinged to the top plate engaging the bottom flanges, and other apertured side pieces hinged to the top plate being connected by strap hinges to the bottom plate.

TOBACCO SMOKER'S DEVICE. — Valeriano Gonzales, Durango, Mexico. This device is in the form of a cigar holder, and also applicable to the end of a pipe, and has a reservoir to collect the nicotine, back of which is a chamber with a sponge saturated with a solution of tannin, while within this chamber is also secured a medicine cup designed to be filled with a readily evaporated medicament, possessing properties beneficial in diseases of the throat and mouth, or any substance which would impart an agreeable flavor to the smoke. The object of the device is to render tobacco smoking always harmless and in some cases particularly beneficial.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS AND PUBLICATIONS.

WOMAN AND HEALTH. A mother's hygienic hand book. By M. Augusta Fairchild, M.D. 1890. Published by the author. Quincy, Ill. Price $2.50.

In this volume a woman undertakes to tell women of their needs in matters relating to maternity, also including specific directions for the treatment and cure of acute and chronic ailments generally. The book is written in dialogue form, and embraces nothing beyond the comprehension of people of ordinary intelligence, dress, dietetics, hygienic cooking, sunshine, exercise, sleep, each forming the subjects of separate chapters.

Steam, its Generation and Use, with catalogue of the manufactures of the Babcock & Wilcox Co., forms a handsome volume of 150 octavo pages, containing a great variety of valuable information in addition to the details furnished relative to this well known style of boilers. The volume for 1891 is the twenty-third edition of the work, which was originally published in 1879, and has been enlarged through the successive editions since issued in deference to the high appreciation with which its facts and figures have been received, no less than the striking success which has attended the introduction and use of the Babcock & Wilcox boilers. The company now has manufactories in the United States, Scotland, France, Germany, and Austria. The book is sent free on application.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(3166) M. L. S. asks (1) for a cement that could be used to cement glass to metal (brass and iron) and which would not be attacked by bisulphide of carbon, water, alcohol, etc. A. Dissolve gelatine in water, add a small percentage of glycerine to render it slightly elastic, also a small quantity of bichromate of potash to make it insoluble. 2. Is there an odorless bisulphide of carbon, and if so, what is its cost and index of refraction? A. Purified and deodorized bisulphide of carbon costs 70 cents per pound. Its index of refraction is the same as that of the commercial article. 3. Just what kind of a lens is a collimating lens? A. Any lens which will bring light rays into the line of vision is a collimating lens. 4. How much heat is there in crude petroleum as compared to coal, equal costs A. In England the difference between the cost of crude petroleum and coal for fuel is as 2 to 1. In this country, there is a slight difference in favor of coal. There are, however, varieties of crude petroleum which are worthless for the purposes of the refiner. As a fuel, this sort of petroleum is more economical than coal. 5. What substances are transparent to heat and how can I make a heat lens? A. Glass is transparent to heat. You can make a heat lens from glass alone, or you can make a hollow glass lens and fill it with carbon disulphide. 6. How can I detect the presence of carbonic acid gas in the atmosphere when in small quantities? A. By passing the air through clear lime water, a very small percentage of carbonic acid absorbed by the solution will produce carbonate of lime, which renders the water turbid. 7. What is the chemical nature of impure and injurious air? A. The nature of impure air varies with the locality. It will be impossible to give a general answer to this query. Ordinary air contains, besides nitrogen and oxygen, a little carbonic acid, a variable proportion of aqueous vapor, a trace of ammonia, and sometimes a little carbureted hydrogen. 8. Does throwing a picture (as in a camera) upon a plate of glass in any wise affect its transparency to other light rays while it retains the image? A. No. 9. Did Professor Herz refract induction, and where can I find the particulars of his experiments for the past two years? A. Professor Herz refracted induction by the use of an asphalt prism. 10. I understand that magnetization affects the length of an electro magnet's core. With what rapidity can this change be effected, *i. e.*, to how many magnetizations and demagnetizations will the core respond in a second of time? A. We do not know that any limit has been discovered. 11. How frequently can the power of a magnet be changed in a second? I do not mean how many times a second can it be completely magnetized and demagnetized, for I understand there is a residual magnetism, but how many times can the strength of a magnet be varied per second? A. No limit has been discovered. 12. How does the resistance of selenium vary from light to darkness? A. Exposure to diffused daylight diminishes the electric resistance of selenium to one-half of what it was before. 13. Is there any work published giving the cost of experimental materials, such as selenium, bisulphide of carbon, etc.? Catalogues of course can be had occasionally containing prices of one or two things required, but has any one ever published an extended list of approximate prices? A. All large dealers in physical apparatus supply catalogues of materials and apparatus. Write the dealers in New York, Philadelphia and Boston. 14. Is it true that light passed through a highly magnetized ring undergoes refraction as if through a lens? If so, why?

A. Light passing through a magnetized ring is not refracted, but in the case of polarized light, its plane of polarization is rotated. 15. Is there any known mechanical means of feeding a wheel forward through successive steps, which steps shall be perfectly gaugeable, and be as desired any portion of the circumference? I desire a positive motion, with stops to prevent slipping or the passage of wheel beyond proper points. A. We think a worm wheel, driven by a worm operated by a pawl and ratchet, would answer your purpose.

(3167) **S. M. K. asks: 1. Have you any** description of a simple air engine of about one-eighth to one-sixteenth horse power? A. You will find caloric engines described in SUPPLEMENT, Nos. 49, 162, 623, 633, 536, 573, 695 and 727. 2. Have you a description of a simple steam engine of about one-eight or one-sixteenth horse power? A. SUPPLEMENT, No. 279, contains a description of such an engine. 3. How can I make a boiler to be put on a stove for use in connection with a small steam engine? A. For small boilers consult SUPPLEMENT, No. 702. 4. Have you directions for making a simple electric motor? A. See SUPPLEMENT, No. 641. 5. How to make a dynamo for 6 or 8 lights? A. Consult SUPPLEMENT, No. 600. 6. How to make a battery for running small electric lights? A. See SUPPLEMENT, No. 792. 7. What is a good treatment for dandruff? A. Wash the head in a weak solution of borax.

(3168) **E. J. H. asks: 1. How can a** luxuriant growth of beard be permanently removed from the face without serious injury to the skin? Will you suggest a course of experiments likely to give the desired result? A. In our SUPPLEMENT, Nos. 178 and 353, you will find the results of the electrolytic method. 2. By Act of Congress, March 22, 1862, $60,000,000 in currency was made full legal tender money. How long did it remain in circulation at par with gold, and at what time, and for what reason was it withdrawn from circulation? A. In December, 1861, the banks suspended specie payments, and there was thereafter a premium on gold until the resumption of specie payments by the government in 1879. The government was sustained, through 1861, by treasury demand notes, payable in coin, but the first legal tender act was for the issue of $150,000. It passed the House of Representatives February 24, 1862, and passed the Senate and was signed by the President the next day. The total authorized issues of legal tenders were $450,000. Subsequent to the war up to 1874, $44,000,000 of legal tenders were retired, as part payment of an acknowledged debt by the government, further payments being restricted because of their acknowledged convenience as currency when the ability of the government to maintain them at par had been demonstrated. During the war and up to 1874, $48,151,000 of fractional currency were issued, the greater part of which had been redeemed before the resumption of specie payments.

(3169) **C. E. R. asks for the mode used** in varnish works to bleach shellac, and if chlorine is used, the cheapest form to make it. A. Two pounds chloride of lime are made into a paste with water, which is strained through a cloth. The residue on the cloth is washed out with two pints of water. For each pound of chloride of lime add 4 ounces carbonate of potassium dissolved in 1 pint of water. Two pounds of shellac have meanwhile been digested in 1 gallon of alcohol for a few days. The above fluid is added with constant stirring to the alcoholic solution. After half an hour enough hydrochloric acid is added to show an acid reaction. The shellac is precipitated as a white tough mass, which is freed from the acid by rinsing and is washed with hot water until the latter comes off clear. The shellac is kneaded or worked into strips and is dried upon a platform or board in the air. The alcohol can be recovered by distillation. Enough carbonate of potash should be added to the original chloride of lime solution to precipitate all the lime. The quantity given is approximate only. Each sample will require a different amount.

(3170) **C. I. sends following receipt and** asks concerning its merits: "A patented shoe blacking, which contains no acid, is made in Germany by dissolving casein in a solution of borax or soda and adding resinate of iron, besides the usual boneblack, grease, and sugar. A brilliant luster is imparted by casein, and the resinate of iron gives a deep black color." A. The receipt is suggestive and worth trying. The doubtful point is as to its lasting black color. The resinate of iron is made by saponifying resin with caustic soda, dissolving in water and adding to a solution of copperas. The iron salt will be precipitated. Filter, wash, and dry it for use. Carbon blackings are given in many places in the SCIENTIFIC AMERICAN.

(3171) **S. L. asks: 1. Which is the best** non-conductor of heat—felt, asbestos, or air? A. Asbestos. 2. Will air inclosed in a vessel hermetically sealed expand by heat? If so, how much, and with what force? A. Air, at atmospheric pressure and with a temperature of 32° Fah. will, when heated to 580°, give a pressure of 15 pounds above that of the atmosphere. 3. Is a partly vacuum a better non-conductor of heat than air? A. Yes. 4. What causes the explosion of kerosene lamps, and stoves. Is it because the gas from the oil comes in contact with the oxygen of the air or with the flame? A. The explosion of kerosene lamps and stoves is caused by the mixture of petroleum vapor driven off by the burner and air. 5. Which is the lightest of all gases? A. Hydrogen. 6. If a vacuum were created in a vessel, would it be lighter than if charged with the lightest gas? A. Yes.

(3172) **P. C. T. asks: 1. What is the** so-called "bottled electricity" used for headache and the caring of catarrh? A. The bottle contains no electricity. It is simply filled with sponge, and the sponge is saturated with oil of mustard. 2. Where does the first electrical impulse come from in the dynamo, as there is no magnetism present when the machine is at rest? A. If there were no magnetism in the cores of the field magnet the machine could not be started. The field magnet of every dynamo retains a little magnetism, which is sufficient to start the inductive process.

(3173) **R. E., Jr., says: We want to use** the water in our mines for boilers, and it is impregnated with sulphur, iron, copper, etc. What method can we use to purify it so as not to be destructive to the iron? A. The best chance of purifying the water is to add enough lime water to precipitate its impurities, and to allow it to settle. Or you may let it stand in wooden tanks with scrap iron. Either method is imperfect and your boilers will undoubtedly suffer whatever you do. After standing over scrap iron, the lime treatment might be used in addition.

(3174) **H. McD. asks for any known** liquid, outside of alcohol, that will not evaporate by exposure, and only freeze at a very low temperature. A. Glycerine.

(3175) **S. M. B. writes: Can you give** me any information of any one who has a process or method of removing salt and alkali from water so that it will render or make the water fit or suitable for making steam? A. Salt and alkali cannot be removed from water in any practical way for boiler use. Run the boiler by the hydrometer, adding new water to keep it at a constant degree of saturation. Blow off frequently from the bottom to expel deposited matter.

(3176) **F. A. S asks how many pounds of** wire there are on armature and on field magnet of the small electric motor described in "Experimental Science," page 497. A. We cannot give the exact amount of wire on the motor referred to, but we think there is about one-third pound on the armature and 1 pound on field magnet.

(3177) **E. V.—To make a mould for ornaments**, etc.: Soak 12 ounces of gelatine for a few hours in water until it has absorbed as much as it can, then apply heat, by which it will liquefy. If the mould is required to be elastic, add 3 ounces of molasses and mix well with the gelatine. If a little chrome alum be added to the gelatine, it loses its property of again being dissolved in water. A saturated solution of potassium bichromate brushed over the surface of the mould, and allowed to become dry and afterward exposed to sunlight for a few minutes renders the surface so hard as to be unaffected by moisture. To prevent the plaster sticking, brush with olive oil.

(3178) **F. H. F.—Since making our** former answer as to the heaviest locomotive used on any railroad in the world, we are informed that the Canadian Locomotive Works, at Kingston, Ont., is building four locomotives for the Chignecto Ship Railway, each of which will have a weight of 45,000 pounds on each of four pairs of drivers, or a total of 180,000 pounds, light, for each locomotive. We know of no locomotives so heavy as this at present in use.

(3179) **A. D. B. asks (1) for the relative** proportion of piston area and length of stroke in gasoline engines, considering the expansive force of the gas (not any particular make of engine). A. There is no fixed rule for the proportions of gas engines; some makers think a stroke at least double the diameter of the cylinder is advisable, while others make the diameter of the cylinder and the stroke the same. 2. How many volumes should the charge be compressed? A. About three. 3. What are the best proportions of gasoline gas and air for greatest force? Also for greatest expansion. A. Eight or nine volumes of air to one of gasoline vapor gives the best results. 4. Would it be practical (considering economy) to admit gas and air (of the proper mixture) in proportion to the load, the same to be compressed in the same space of a full charge? A. A variable mixture does not work well in practice.

(3180) **C. A. H. asks: In rewinding a** small electric motor, say about one-eighth horse power, to adapt it to Edison 105 volt circuit, what should the resistance be in the fields and armature, and the best way to connect up shunt or series? A. The resistance of the machine should be such as to use the amount of current required for the power needed. An electrical horse power is 746 watts. A watt is one ampere multiplied into a volt. If you require one-eighth horse power, you will need about 93 watts. Your E. M. F. is 110 volts; therefore, if you divide the voltage by the number of watts, you will have the current in amperes required, which is 1·18 amperes. Now, to arrive at the total resistance of the machine, you will divide the voltage by the amperage, which will give you 92 ohms. Of this amount, if the machine is series wound, the resistance of the field magnet should be about one-half that of the armature, while if it is shunt wound, the resistance of the field magnet should be about fourteen times that of the armature.

(3181) **S. R. S. asks: How can I remove** a wart? A. Cover the skin around the wart with lard; apply over the surface of the growth one or two drops of strong hydrochloric or nitric acid; then keep the part covered up until the scab separates.

(3182) **C. G. C. asks: How can I re-**move rust stains from nickel plate? A. Grease the rust stains with oil, and after a few days rub thoroughly with a cloth moistened with ammonia. If any spots still remain, remove them with dilute hydrochloric acid and polish with tripoli.

(3183) **W. P. S. asks: 1. How can I make** the black enamel used on bicycles? A. For temporary use to cover places where the enamel has been chipped, use asphaltum dissolved in turpentine. If the whole machine needs japanning, send to the factory and have it japanned. 2. What cement must I use to cement on the tire? A. Melt together equal parts of pitch and gutta percha; use hot. 3. What cement can be used to mend cuts? A. Use the following: carbon bisulphide, 5 oz.; gutta percha, 5 oz.; pure unvulcanized rubber, 10 oz.; fish glue, 2½ oz. Use no more than necessary, and bind the tire firmly with string until the cement has set. 4. What oil is used to oil bicycles and typewriters? A. Use sperm oil.

(3184) **E. H. R. asks how to remove ink** stains from an oak desk. A. Try a mixture of two parts of cream of tartar and one of powdered alum.

(3185) **F. B. D. asks how to make tin** foil labels adhere to block tin collapsible tubes. A. Use a mixture of the best fish glue and gum arabic dissolved in water. A little glycerin may be added to advantage.

(3186) **J. C. asks: 1. What kind of** wax is used in making wax flowers, and how is it prepared? A. Use nothing but the purest virgin white wax; a little of the finest grade of Venice turpentine is added to render it ductile. It must not be melted in an iron pan; use tin or enamel ware; when stiff leaves are to be made, a little spermaceti may be added. The colors in fine powder are mixed with essence of lavender and this paste is mixed in with the wax. Pour in moulds while still warm. 2. How is beeswax bleached? A. Melt the wax in a jar and put into it sodium nitrate in the proportion of one ounce to the pound of wax; add afterward by degrees two ounces of sulphuric acid diluted with ten times its weight of water. Keep the wax warm and stir. Let it stand a short time, then fill up the jar with hot water, and allow the whole to cool. Afterward wash with water to remove any nitric acid stains that may remain, or finely shred it and expose to the sun for several days.

(3187) **A. M. asks: How can I obtain a** fine gloss on collars and cuffs? A. Melt 2½ lb. of the very best A 1 paraffine wax over a slow fire. When liquefied, remove from the fire and stir in 100 drops of citronella. Have ready some round tin pie plates (new); place them on a level table, coat them slightly with sweet oil, and pour about six tablespoonfuls of the enamel into each tin. The pan can be floated on water to cool it. Break up into pieces the size of a lozenge. Two of the pieces added to each pint of starch will cause the smoothing iron to impart the finest possible finish, leaving the clothes perfumed. See SUPPLEMENT 577.

(3188) **W. S. B. says: 1. In toning prints** they sometimes assume a deep red color, which cannot be removed, although the print is left in the solution for hours. The redness sometimes covers the whole print and is sometimes in spots. I wash my prints in running water for half an hour. What is the cause and how can it be remedied? A. The redness is due to too acid a toning bath, or insufficient gold in the bath. See that the toning bath is alkaline, and test with a piece of red litmus paper, which should turn blue if the bath is alkaline. 2. Are time exposures preferable to instantaneous? A. Yes.

(3189) **T. P. R. asks how to prevent** photographs from fading. A. See formula on page 10621, SCIENTIFIC AMERICAN SUPPLEMENT, No. 665. Keep the photograph in a dark place.

(3190) **J. Z. G. asks why lead castings** sometimes crack while cooling. A. The cracking of lead castings is due to shrinkage, and generally occurs in sharp angles. All metals are liable to shrinkage cracks in the recessed angles, unless filleted.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

July 14, 1891.

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Acid, manufacture of tartaric, R. W. Schedler	455,788
Addressing machine, G. S. Couch	455,814
Armature for dynamo-electric machines, E. W. Rice, Jr	455,887
Armature for dynamos, F. L. McGahan	455,971
Assorting machine, H. H. Hutchins	456,092
Axle coupling, vehicle, J. J. Morrison	455,849
Axle cutter, J. Swegles	455,835
Axle, self-oiling car, R. P. Sholl	455,841
Bag fastening, traveling, C. F. Kurz	456,040
Bait cage, S. Moulsong	455,758
Baling press, C. E. Bates	455,731
Baling press, E. M. Pine	456,057
Ballot box, A. Reppmann	455,765
Banjo, F. Gretsch	456,029
Barrel, Tinker & Benjamin	456,099
Bating powder, H. Poydenot	455,851
Batteries, terminal for electric, Hayes & Hibbard	455,985
Battery plate, secondary, J. R. MacLaughlan	455,968
Bed couch, G. Goldschmidt	455,921
Bedstead, etc., iron, C. A. Sprague	455,976
Beer buck, F. T. Cladek	455,937
Bell, E. D. Rockwell	456,062
Belt, electric, L. N. Fancher	456,021
Belt tightener, C. A. Norlin	455,790
Belting, C. A. Schieren	455,852
Berth safe, J. A. Brittain	456,010
Bevel, P. J. Mabye	456,044
Bicycle, W. F. Cornelius	455,864
Bicycle, Hueisen & Nagel	455,945
Blind, Venetian, Simmons & Angus	455,912
Board. See Game board.	
Boiler. See Dinner boiler. Steam boiler.	
Boiler, O. W. Noble	456,000
Book support and desk, H. J. Harrison	456,089
Books, binding, J. H. Workman	455,894
Boom stick, D. W. Case	455,906
Boot or shoe, S. C. Howard *et al.*	455,847
Bottle stopper, G. S. Chamberlin	455,737
Bouquet holder, N. R. Sheets	455,928
Box. See Ballot box. Fare box. File box. Letter box. Locomotive sand box.	
Brake. See Car brake. Vehicle brake.	
Brake regulator, automatic, F. Moore	455,902
Brake staffs, pawl and ratchet mechanism for, Emerson & Emery	456,086
Brick mould and press, C. W. Raymond	455,951
Brush, F. Consene	455,740
Buoy, bell, J. Gibson	455,746
Bureau and commode, Merritt & Taylor	455,863
Burner. See Vapor burner.	
Butter moulds and vinegar measures out of wood, machine for manufacturing, F. K. Winsor	455,862
Button, J. M. Crews	455,908
Car brake, S. R. Lewis	455,753
Car brake, T. D. Osborne	455,987
Car, cable, J. Stephenson	455,774
Car coupling, J. M. Birtels	456,080
Car coupling, M. Howe	455,795
Car coupling, J. Kormil	456,039
Car coupling, S. W. Wright	456,074
Car gate, railway, F. C. Cash	456,017
Car safety attachment, B. C. Seaton	456,126
Car seat, E. L. Bushnell	456,015
Car, street, Smith, Jr., & Williamson	455,842
Car trolley, electric, W. H. Knight	455,798
Cars, street and station indicator for, G. H. Tietjen	456,096
Carding engines, grinding the flats of traveling flat, W. Dobson	455,963
Carpet stiffener, M. Lincoln	456,012
Carpet stretcher, clamp, L. Hinkle	456,001
Carriage, baby, Davis & Dicks	455,909
Carriage, spring, J. D. Brunner	455,736
Carriages, shifting seat for, J. T. Clarkson	455,738
Cart, road, Kirkpatrick & McDaniel	455,831
Cart, road, S. D. Palmer	456,056
Cart, road, L. M. Smith	455,980
Case. See Display case. Show case.	
Cash register, C. Angus *et al.*	455,916
Caster, furniture, A. E. Brown	455,905
Centrifugal machine, T. Muller	455,832
Chair iron, tilting, A. E. Quinlan	455,808
Chamber attachment, noiseless, V. M. Cone	455,977
Chart, dress, E. Hood	455,749
Chimneys, construction of, A. Boettcher	456,109
Churns, means for operating, L. H. Conner	455,739
Cigar stamping machine, G. F. & J. W. McIndoe	455,830
Clamp. See Easel clamp.	
Clasp. See Pocketbook clasp.	
Clip. See Thill coupling clip. Yoke clip.	
Closets, etc., hermetical cover with cleansing apparatus for, Siemang & Gufttmann	455,975
Clothes line elevator, E. E. Taylor	456,070
Clothes rack, W. R. Freeman	455,874
Clover hullers, feeder for, A. B. Reeves	455,898
Clutch, W. C. Wright	455,978
Coat hook, H. C. Hart	456,090
Comb. See Curry comb.	
Commutators, holder for carbon brushes of, C. H. Farrington	455,856
Cooking utensil, I. Stegemann	455,806
Copier, letter, E. W. Wickey	455,828
Cork, treating, J. T. Smith	456,098
Corkscrew, D. W. Davis	455,896
Coupling. See Axle coupling. Car coupling. Thill coupling. Vehicle coupling.	
Cultivator, A. Lindgren	455,755
Cultivator, H. S. Moore	456,050
Cultivator, J. V. Webster	455,914
Cultivator, lister, W. Y. Smith	456,005
Cultivator, tongueless wheel, A. Lindgren	455,754
Current motor, alternating, Stanley, Jr., & Kelly	455,773
Curry comb, C. S. Starr	455,980
Curtain fixture, W. Bishman	455,969
Cutter. See Axle cutter.	
Damping apparatus, W. N. Cornell	455,741
Dead centers, mechanism for overcoming, L. Hauck	456,031
Dice throwing apparatus, M. Vogelgesang	456,091
Dinner boiler, R. J. Nourse, Jr	455,760
Dish washer, F. S. Miller	455,998
Display case, I. M. Smith	455,770
Door mat, W. B. Curtis	456,085
Draught equalizer, J. G. Stowe	455,861
Drain pipe, H. E. Ogden	455,986
Drill. See Rock drill.	
Drinking fountain for fowls, L. B. Lord	455,756
Dyestuff, brown, C. Ris	455,952
Dyestuff, red, M. Ceresole	456,081
Easel clamp, E. H. Friedrichs	455,844
Electric cut-off apparatus, E. W. Rice, Jr	455,805
Electric indicator, R. C. Eldredge	455,855
Electric machine or motor, dynamo, J. B. Ents	455,790
Electric motor, H. H. Porter	455,765
Electric motor or dynamo-electric machine, C. G. Curtis	455,898
Electric switch, Dahlgren & Svensson	455,837
Electricity, apparatus for administering, G. H. Bethel	455,981
Elevator. See Clothes line elevator. Skirt elevator. Sucker rod elevator.	
Elevator, C. W. Baldwin	456,106
Elevator, T. W. Heermans	455,794
Elevator, G. B. Mills	456,048
Elevator controller, C. W. Baldwin	456,107
Elevator controlling device, G. H. Reynolds, 456,121 to	456,123
Elevator indicator, C. Ludovici	455,947
Elevator operating machine, N. C. Bassett	456,108
Elevators, means for controlling, G. H. Reynolds	456,124
Embossing machine, F. Berner, Jr	456,079
Engine. See Rotary engine. Steam engine. Traction engine.	
Engine indicators, device for operating steam, J. Gill	455,929
Engines, accumulator for direct-acting, C. C. Worthington	455,995
Extractor. See Honey extractor. Juice extractor.	
Fare box, J. L. Kall	455,881
Feed water heater and purifier, W. Webster	456,072
Fence, H. A. Fenner	455,940
Fence, G. P. Ruhle	456,064
Fence making implement, wire, McCormack & Craig	456,086
Fence strands, tool for joining wire, J. D. Jones	455,869
Fence, wire, A. F. Dickey *et al.*	456,022
Fencing, die used in making sheet metal, T. V. Allis	455,867
File box, knockdown, H. C. Yeiser	456,075
Filter, Manwaring & Vanderhoef	456,119
Fire alarm apparatus, Chase & Eaton	455,812
Firearm sight, W. Lyman	455,911
Fire escape, Schneider & Maschino	456,002
Flask. See Moulder's flask.	
Flower holder and fly trap, combined, J. Rosenfeld	455,888
Folding gate, Bayer & Scherbner	455,960
Fork, T. Hausler	456,032
Fountain. See Drinking fountain.	
Frame. See Sewing machine quilting frame.	
Game board, G. M. Snow	456,069
Garment hook, H. M. York	455,903
Gas in gas service pipes, means for equalizing the pressure of, W. A. Walker	455,913
Gas, machine for generating illuminating, D. S. Green	456,116
Gas, prepayment attachment for vending, R. W. Brownhill	456,011
Gate. See Car gate. Folding gate.	
Gate, G. H. Damon	456,020
Glove, Hooper & Moore	456,035
Governor, J. H. Hamilton	456,095
Grain cleaning, mill, L. Bartholomew	456,077
Grain separating screen, C. Closz	455,998
Grain separator, C. Closz	455,997
Gun, air, C. J. Hamilton	455,942
Hammer, A. F. Street	455,776
Hammer, automatic, E. Thomson	455,906
Handle. See Pendent handle.	
Harness, E. Walrath	455,991
Harvester, corn, W. Orcutt	456,055
Hatchway doors, device for operating, C. K. Rogers	456,063
Hay rack, C. Zengler	455,895
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